



A Novel Technique: Ultrasonography-Guided Botulinum Toxin Injection in Adductor Type Spasmodic Dysphonia

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새로운 접근법: 내전형 연축성 발성장애 환자에서 초음파를 이용한 보툴라눔 독소 주입술

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Spasmodic dysphonia (SD) is a rare disease caused by focal dystonia in the laryngeal muscles. The adductor type SD (AdSD), which affects the thyroarytenoid (TA) muscle, is found in 80% of all SD patients. For them, voice therapy and medication are less effective and definitive surgical treatment has not been established yet. Botulinum toxin injection is considered the gold standard treatment. However, patients require regular injections every 3–6 months whenever the effect of botulinum toxin disappears. Therefore, it is essential that injecting botulinum toxin is safe, comfortable, and accurate. Injections are usually performed under the guidance of electromyography or laryngoscopy. Ultrasonography (US) is a familiar device to otorhinolaryngologists and has recently been used to evaluate the laryngeal structures. While US has been used only for diagnosis, it can also be used for treatment. Here, we describe a novel technique that can be used to inject botulinum toxin into the TA muscle via trans-cartilaginous approach under the guidance of US for the treatment of AdSD.

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Introduction

Spasmodic dysphonia (SD) is a rare disease caused by focal dystonia in the laryngeal muscles. Task-specificity—symptom worsening when talking or reading a book and improving during physiologic voice tasks such as laughing or singing—is the most important characteristic of SD. Adductor type SD (AdSD), which presents as a strained or tight voice due to excessive contraction of the thyroarytenoid (TA) muscle, accounts for 80%–90% of patients with SD. Abductor type SD, which

presents as a whisper-like or breathy voice due to sudden spasm of the posterior cricoarytenoid muscle, accounts for 10%–17% of all SD patients. While voice therapy and medication can be used for the treatment of SD, the therapeutic effect is limited and they are used only as supportive treatment. Surgeries, such as thyroplasty and selective laryngeal adductor denervation-reinnervation may be considered; however, the definitive surgical treatment has not been established. Botulinum toxin injection into the affected muscle is the gold standard of the treatment of SD.¹⁾ The injections are usually performed under electromyography (EMG) guidance, with the injections under laryngoscopy guidance recently showing excellent therapeutic effects.²⁾ However, because the effect of botulinum

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toxin is temporary, patients require regular injections every 3–6 months. Thus, the demand for the safe, comfortable, and accurate botulinum toxin injections has increased.

Head and neck ultrasonography (US) is a familiar method that is easily performed by otorhinolaryngologists treating voice disorders. Park, et al.³⁾ reported the usefulness of US in laryngeal EMG to show the exact insertion of the needle electrode and prevent complications. Some thyroid surgeons have described a novel US lateral approach to evaluate the mobility of the vocal cord after thyroidectomy.⁴⁾ However, these methods were limited to using US only for diagnostic purposes. US is a versatile tool that can be used for both diagnosis and treatment.

Therefore, we introduce a novel treatment technique of directly viewing the TA muscle and injecting botulinum toxin under US guidance in patients with AdSD.

Subjects and Methods

This work was conducted with the approval of the Institutional Review Board (YUMC2020-02-037-001).

Pre-procedure work up

Laryngoscopy and stroboscopy were performed to identify any structural abnormalities in the larynx and true vocal cord mucosa. Objective voice evaluation was done through auditory-perceptual assessment, acoustic analysis, and aerodynamic analysis. Subjective voice discomfort was assessed using the Voice Handicap Index questionnaire.

Procedure preparation

The patients were placed in a supine position and prepared for the US on the right side. Next, the injection was prepared

using 1.5–3 IU botulinum toxin and a 25-gauge needle in a 1-cc syringe. Generally, local anesthesia was not required. However, if the patients sensitive to pain were administered 2% lidocaine to the skin and subcutaneous tissue.

Procedure

The probe was placed from the apex of the thyroid cartilage to the posterior lamina perpendicular to the thyroid cartilage to provide the longest view of the vocal cord. The laryngeal structures were scanned through the lateral approach and landmarks such as vocalis muscle, arytenoid cartilage, and vocal tract were identified (Fig. 1).⁴⁾ The movement and exact location of the TA muscle were then confirmed through phonation. Next, the needle was inserted into the TA muscle by penetrating the thyroid cartilage using the vertical technique as in fine needle aspiration biopsy. The probe was rotated up and down while attached to the thyroid cartilage to check the exact location of the needle tip. The botulinum toxin was then injected, ensuring that the drug appeared hyperechoic in US did not leak out of the target muscle (Fig. 2). The patients were observed carefully for breathing problems or aspiration signs. The opposite side was injected in the same manner soon after.

Post-procedure care

We checked for side effects after 30 minutes at the outpatient clinic. The patients were instructed to fast for 2 hours and take a voice rest for 1 day, and were then discharged from the hospital. The patients were followed up at 2 weeks and 1 month after the procedure. We explained to the patients that the effect of the botulinum toxin lasted for approximately 6 months and instructed them to return to the outpatient clinic whenever they wanted an additional procedure.

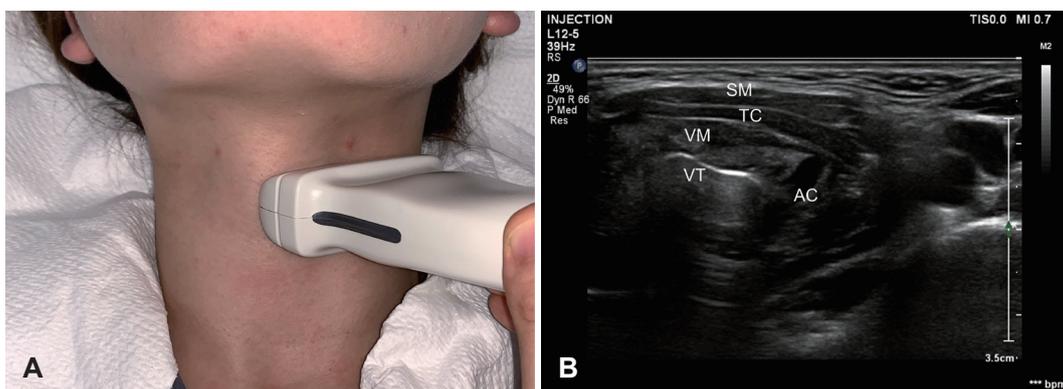


Fig. 1. Ultrasonographic findings around the laryngeal muscles. A: Ultrasonography (US) position during procedure. B: Laryngeal structures seen through the US lateral approach. SM, strap muscles; AC, arytenoid cartilage; TC, thyroid cartilage; VM, vocalis muscle; VT, vocal tract.



Fig. 2. Ultrasonography (US)-guided botulinum injection in adductor type spasmodic dysphonia. A: US and needle position during procedure. B and C: The needle tip is located in the left thyroarytenoid (TA) muscle (B), botulinum toxin solution was well injected in the left TA muscle (C). O indicates the needle tip. *indicates the injected botulinum toxin solution.

Results

With this novel technique, 10 patients were injected 25 times, that is, 50 injections into the bilateral TA muscle, from 2020 to the present. We observed no cases of insufficient, incorrect, or unsuccessful injection during the procedure. The patients' voices improved and no specific side effects occurred.

Discussions

A recent clinical review reported no preference between surgery or botulinum injection in the treatment of SD, with both treatment groups showing good results. Although surgery has the advantage of a permanent effect, it has the disadvantages of the risk of anesthesia, operation time, and impossibility of checking real-time for voice color change during operation. While several surgical techniques are used, including TA myotomy, thyroplasty, selective laryngeal adductor denervation-reinnervation, laryngeal nerve crush, and recurrent laryngeal nerve resection, the definitive surgical treatment for SD is not established and the long-term effect of surgeries is insufficiently studied.⁵⁾

This study introduced the method for injection under US guidance which has several advantages. First, the needle and process of botulinum toxin injection can be observed directly. Although the action potential is visualized during EMG guidance, needle tip is not. The largest disadvantage under laryngoscopy guidance is the inability to see the needle tip. Visualizing the needle tip reduces the risk of failures such as injecting in the wrong space or insufficiently. Second, injection under US guidance can be performed without an assistant. EMG and laryngoscopy require several assistants. Third, this method can be performed comfortably while the patient is lying down, without requiring anesthesia or phonation tasks. In EMG guid-

ance, patients must phonate while the EMG needle is inserted into the target muscle to measure the action potential. The phonation task can cause needle displacement and inaccurate injection. In laryngoscopy guidance, patients feel pain and discomfort due to the scope insertion through the nasal or oral cavity. Moreover, local anesthesia is unavoidable in the laryngopharynx. Fourth, injections under US guidance are performed in less than 1 minute per side. It is far shorter than the other methods (Supplementary Video 1).

There are some drawbacks to this approach. First, US equipment is required. Second, due to the US characteristics, it is operator dependent and time is required to acquire proficiency. However, this technique can be learned together with other US techniques, such as fine needle aspiration, core needle biopsy, and sclerotherapy, to allow more rapid mastery. Before reaching the learning curve, it is recommended to perform it on thin patients whose laryngeal structures are clearly visible. Third, it may be difficult to evaluate the larynx and find the needle tip if there is an ossification in the thyroid cartilage. However, since AdSD mainly affects young women and their thyroid cartilage is unlikely to be ossified. According to Bozzato, et al.,⁶⁾ as the operator is sufficiently proficient in US, there can be no difficulty in the procedure even in the presence of thyroid cartilage ossification. Although our techniques have not failed due to the thyroid cartilage ossification, it is necessary to analyze the validity of laryngeal evaluation in patients with thyroid cartilage ossification through the additional attempts to many patients. It is important to freely change the approach to the flexible laryngoscope or EMG guidance for the patients whose structures of the larynx was not clearly visible due to severe ossification.

Since SD is a rare disease that is managed with periodic injections, patients may get sensitive and depressed. Therefore, patient awareness that the injection can be easily performed

with less discomfort will be helpful. Moreover, various techniques should be mastered as they can be used complementarily. The most appropriate injection method should be tailored to each patient.

In conclusion, botulinum toxin injection into TA muscle via the trans-cartilaginous approach under US guidance is one method for the successful treatment of patients with AdSD.

Supplementary Video Legend

Video 1. Ultrasonography-guided botulinum toxin injection to both thyroarytenoid muscles via trans-cartilaginous approach in patient with adductor type spasmodic dysphonia.

Supplementary Materials

The Data Supplement is available with this article at <https://doi.org/10.3342/kjorl-hns.2023.00038>.

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