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Correlation between clinical response and injection quality in treatment of spasmodic dysphonia

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Abstract
Botulinum toxin injection is an effective treatment for spasmodic dysphonia. There are ethical difficulties in performing a controlled placebo trial to assess the effectiveness of this treatment. This paper shows a significantly decreased clinical response following technically poor injections given to patients who respond well to good quality injections.

Key words: Dystonia; Larynx; Voice disorders; Botulinum toxins

Introduction

Injection of botulinum toxin into laryngeal muscles is now a well recognized and efficacious treatment for spasmodic dysphonia. When the injection is performed percutaneously the procedure is essentially blind, despite electromyographic guidance. The injection may be assessed to be less than satisfactory due to one of many reasons. Such an unsatisfactory injection could be expected to produce a diminished clinical response. This study correlates the clinical response with variations in injection quality.

Materials and methods

Twelve patients with adductor spasmodic dysphonia who had previously responded well to botulinum toxin injection were included in this study. The injections were performed in the recumbent position with the neck extended. Both thyroarytenoid muscles were injected under local anaesthesia, percutaneously , trans-cricothyroid under EMG control via a teflon-coated hollow monopolar 22 gauge EMG recording needle (Blitzer *et al.*, 1985).

Injection procedure

The skin over the cricothyroid membrane was cleaned with an alcohol swab. A small amount of local anaesthetic was injected subcutaneously. The EMG needle was mounted on a 1 ml syringe charged with 0.1 ml of botulinum toxin solution made-up to contain 3.3 units of toxin and was connected to the EMG recording machine. The larynx was entered through the cricothyroid membrane in the midline. A change in the EMG tone confirmed that the needle had reached laryngeal air. The needle was then withdrawn slightly until it touched the mucosa (change in tone again) and then advanced upwards and laterally to impale the thyroarytenoid muscle. Correct placement was confirmed by a change in the tone of the EMG and observation of electromyographic activity of resting muscle. These responses increased on inspiration and phonation. The syringe plunger was withdrawn slightly to avoid injecting vessels and then discharged slowly into the muscle. The same procedure was repeated on the other side. The patient was instructed to hold his/her breath and to avoid coughing and swallowing during the injection. This gagging response could be decreased by spraying a little local anaesthetic into the laryngeal lumen while anaesthetizing the skin. The cough initiated by this spreads the anaesthetic to coat the larynx. Care should be taken to inject only a small amount of anaesthetic under the skin as the position of the cricothyroid membrane can be easily obscured in the female larynx. The procedure itself takes approximately 10 seconds and is tolerated by many without an anaesthetic.

The technical quality of injection procedure was assessed subjectively and graded into one of three grades by the injector: AA: satisfactory injection into each thyroarytenoid; AB: one satisfactory and one unsatisfatory injection; BB: both injections unsatisfactory.

Patients were not given any information about the perceived quality of the injection. All patients kept a weekly record of side-effects and voice quality until the next injection. A weekly telephone interview assessed the same and reinforced the need to keep up-to-date records. These responses were then compared with the injection quality.

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Results and analysis

Twelve patients had two treatment sessions each, making a total of 48 injections assessed. Of these, 40 injections were graded as A and eight as B. This translated to 18 treatments classed as AA, four as AB and two as BB.

In group AA the improvement in voice quality lasted for an average of 12 weeks. This was described as excellent for 11 weeks after which it began to deteriorate. Patients in this group were reinjected at 14 weeks. In group AB the improvement lasted for seven weeks, the deterioration beginning after four weeks. The four patients in this group were reinjected at 10 weeks. In group BB no patient had any improvement in the quality of voice. There were mainly two side effects—a weak breathy voice and aspiration of fizzy drinks. These lasted for one week in each of the three groups. The difference in the duration of voice improvement between group AA and AB is shown in Figure 1 and is statistically significant $p = 0.005$ (t test, two-sample assuming equal variances).

Three patients in group AB had subsequent AA injections and they are included in the 18 patients in that group. Their response was no different to the rest of the patients in that group. The fourth patient had previously had an AA injection and his response was the same as others in that group. He has since had an AA injection and seems to have a good clinical response.

One of the two patients in group BB subsequently had an AA injection with the expected good response. The other chose to have further treatments elsewhere.

Discussion

This clinic for management of spasmodic dysphonia was established not long before this study was started. The high incidence of unsatisfactory injections (16 per cent) was due to my inexperience. With increasing experience this rate has now declined to a respectable five per cent. The other main cause of unsatisfactory injections is the strong stimulus to the larynx that initiates swallowing and coughing and prevents the larynx from being kept still during the procedure.

Some of these patients were being successfully treated at a clinic elsewhere. After hearing of our clinic on the 'dystonia grapevine' they came here to avoid travelling long distances. The majority were newly diagnosed patients from this clinic.

A successful injection requires an intimate knowledge of the internal anatomy of the larynx. The thyroarytenoid muscles are approached inferiorly. Appreciation of the laryngeal anatomy from this perspective is not normally obtained in clinical practice. It is therefore necessary to relearn the internal laryngeal anatomy by cadaver dissection and injections so that the needle may be correctly placed in this essentially blind procedure. The EMG only confirms that the needle is in contact with a muscle.

Botulinum toxin causes a presynaptic motor endplate blockade, preventing release of acetylcholine thus causing muscle paralysis. Three units of botulinum toxin into each thyroarytenoid muscle is expected to produce an improvement in voice for an average of four months and side-effects for a week (Blitzer and Brin, 1991). There is a linear dose-response relationship of muscle paralysis until the optimum dose is reached (George *et al.*, 1992). The clinical response is reduced if only one of the two muscles is treated (Zwirner *et al.*, 1993). In this study when the injection on one side was unsatisfactory, the clinical response was of comparable quality but for a shorter duration.

All patients who had unsatisfactory injections had a previous or subsequent satisfactory injection with a clinical response similar to the rest of their group, confirming that this diminished response was primarily related to the injection procedure.

Troung *et al.* (1991) performed a controlled double blind placebo study on the effectiveness of botulinum toxin injections into the thyroarytenoid muscles for adductor spasmodic dysphonia and found it to be an effective treament. Given that spasmodic dysphonia responds so well to this treatment, we felt it would be difficult to recruit patients and unethical to perform such a double blind placebo trial. These results show a correlation between the quality of injection and the clinical response.

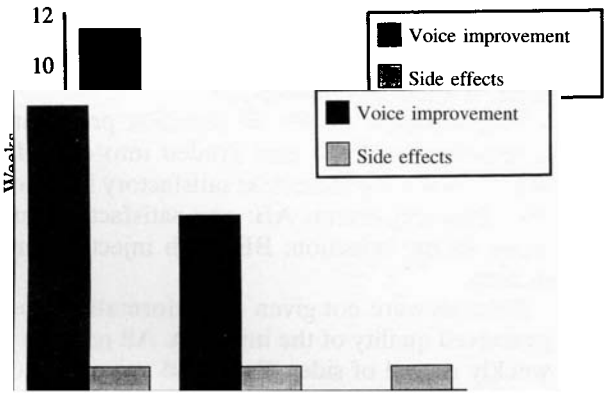

FIG. 1
The difference in the duration of voice improvement between group AA and AB ($p = 0.005$).

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