Usefulness of ultrasound-guided injection of botulinum toxin in patients with neurological disorders that present with hypersalivation

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Learning objectives

1. To investigate the safety and efficacy of ultrasound guided botulinum toxin type A (BTX-A) injections into salivary glands for the treatment of sialorrhoea in patients with neurological disorders.

2. To learn the basic steps to perform a good procedure.
Background

A).- Pathophysiological basis: understanding the problem from the beginning.

• Sialorrhoea is a condition characterized by an excessive production of saliva or drooling. Drooling may occur by increased saliva production or by an alteration in the swallowing mechanism, as in the case of certain neurologic patients. It is a disorder that occurs relatively frequently (about 10%) in patients with certain neurological diseases, being the most frequent cerebral palsy, Parkinson's disease, traumatic encephalopathy, stroke in posterior territory and Lateral Amyotrophic Sclerosis. Comparatively, primary drooling is rare.

• Although this entity does not put in risk patient's life, it causes a great impact on their quality of life. The origin of the problem is the loss of control of the muscles of the tongue and swallowing mechanism that are necessary to move the saliva from the oral cavity to the oropharynx. It is accompanied by perioral irritation, dripping saliva, oral infections, dehydration, bad odor and bad hygiene, and interference with feeding as well as social interaction. A normal adult produces about 1.5 liters of saliva daily and 95% is produced in the major glands (parotid, submandibular and sublingual).

B).- Review of the different treatments of sialorrhea.

• Treatment options:

There are several treatment options for sialorrhoea, such as anticholinergic medications (effective, but with significant side effects such as blurred vision, urinary retention, arrhythmias ...), antireflux, radiotherapy (used in elderly patients who can not tolerate oral via and when surgical options are contraindicated), surgery (either excision, duct dilatation or relocation) which is reserved for the most serious cases and non-responders.

• The relevance of Botulinum toxin:

1. It is one of the most recent treatment options: intraglandular injection of botulinum toxin. Although botulinum toxin has multiple therapeutic
indications, its use in salivation pathology has been recently proposed. Clostridium botulinum neurotoxin produces the inhibition of the acetylcholine release in the presynaptic binding in the salivary glands. This effect was first described in 2000, in a patient with Parkinson’s disease.

2. For the injection of the toxin there is a wide variety of methodology, such as electromyography, anatomical markers (1 cm ahead the tragus ear and one centimeter at 90 degrees down) or the ultrasound-guided injection. There is also variability in the glands over which perform the toxin administration; most studies do both parotid and submandibular and bilaterally. However, there are publications where only parotid or contralateral parotid and submandibular glands are injected.

3. The **reduction in the drooling begins to be notice at 4-5 days** and the peak of the significant improvement in patient’s symptoms occurs in the 4th week after injection.
Findings and procedure details

• The role of ultrasound in the treatment of hypersalivation:

1. Basic steps to make a good procedure.

• There are 2 possible patterns of administration: less than 50U dose administration (low dose protocol) and administration of more than 50U (high dose protocol), although with both of them a significant reduction of hypersalivation is achieved. The total dose of toxin to administer was estimated by the quantity of salivation and patient weight, taking into account that the effective dose to stop at least 50% of saliva production is 1.5 units per kg applied in the parotid gland and 1 unit per kg in submaxillary gland. Submandibular glands injection should be done at a single point, while in the case of parotids it can be performed on one or two points.

• In our experience, good results are obtained with a total dose of 100U of BTX-A injected at a single point of each parotid and submandibular gland. Thus, although the average duration of the effects of the toxin in other fields is around 3-4 months, we get symptomatic improvement for a period of 6-9 months.

• Basic steps:

1. Before injection, we must perform an ultrasound study to know the gland anatomy, if there is atrophy / agenesis of some of them, the vascular anatomy of the parotid and submandibular glands, as well as the intraparotid facial nerve, using a linear 12 Mhz ultrasound transducer.
2. Not only we must avoid the major vessels, but also hypervascular areas, for an optimum placement of the needle.
3. Never inject the toxin if the tip of the needle is not within the glandular parenchyma or if you are in the lumen of a vessel.
4. Once you have located the optimal puncture site, ultrasound-guided toxin injection can be performed.

2. Advantages of ultrasound-guided injection of Botulinum toxin over other treatments:

- It is a minimally invasive procedure.
- Limited side effects (up to 40% of patients treated with scopolamine showed side effects).
- High safety and effectiveness.
- Reduction in the risk of aspiration and pneumonia in patients with neurological disorders in which the incidence of those entities is usually increased.
- The surgical option has the same effectiveness but gets a more lasting effect, which could be solved with a new injection of toxin.

• **Outcomes (included complications):**

No serious side effects or procedure related complications occurred in our experience. The most common side effects include increased viscosity of saliva (4%), dysphagia (3.3%), dry mouth (3.3%) and pneumonia (2.2%).
Images for this section:

![Ultrasound of parotid gland](image_url)

**Fig. 1:** Ultrasound of parotid gland in a patient with biopercular syndrome with normal sonographic features.

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Fig. 2: Submandibular gland ultrasonography in a patient with Parkinson's disease. A normal morphology and echostructure is seen.

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Fig. 3: Ultrasound-guided needle placement (yellow arrows) for intraglandular botulinum toxin injection in the submandibular gland.

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Fig. 4: Ultrasound-guided injection (needle: yellow arrows) of botulinum toxin in submandibular gland, confirming the intraglandular location of it (red arrowheads).

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Fig. 5: Ultrasound-guided needle placement (arrows), above the retromandibular vein, for intraglandular injection of BTX-A.

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**Fig. 6:** Ultrasound-guided injection of BTX-A in parotid gland, confirming the intraglandular location of it (red arrowheads).

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Conclusion

1. The injection of BTX-A into the salivary glands may be a valid treatment option in patients with sialorrhea, since it is able to improve quality of life.
2. Ultrasound-guided BTX-A injection enhances efficacy and patient safety.
3. Side effects are rare and less relevant than with other treatments.
4. Future studies will need to further evaluate technique and examine dosages required to achieve optimal outcomes.
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