Remote cerebellar hemorrhage has been defined as bleeding within the cerebellar parenchyma, a rare complication that can occur after neurosurgical intervention. The entity was first described in the 1970s, by Yasargil et al.[1]. The reported incidence of remote cerebellar hemorrhage after supratentorial interventions ranges from 0.08% to 0.6%[2]. However, it has been reported to occur after various other surgical procedures involving the cranium or spinal cord[2–7].

Several hypotheses have been suggested to explain the appearance of bleeding in the cerebellum away from the primary (supratentorial or spinal) surgical site. One such hypothesis is that resection of a supratentorial lesion creates a pressure gradient, resulting in suction on the cerebellar veins, particularly in the upper portion of the vermis[8]. However, there is another hypothesis that might explain the two findings in the case reported here. That hypothesis is based on the supposition that opening the cisterns or the ventricular system promotes intracranial hypotension, triggering the process that culminates in the distension and rupture of cerebellar veins, resulting in cerebellar hemorrhage [9].

Various neurosurgical procedures have been associated with the occurrence of remote cerebellar hemorrhage, including the clipping of aneurysms (ruptured or otherwise), tumor resection, drainage of parenchymal or extra-axial hematomas, and spinal surgery[2–7,9]. In imaging examinations, remote cerebellar hemorrhage has a characteristic presentation, with a tendency for the blood to be distributed among the cerebellar folia with a curvilinear configuration. This aspect results in the pattern known as the zebra sign[8].

The symptoms of intracranial hypotension syndrome include headache that is orthostatic in presentation, tending to improve in the recumbent position. In imaging studies of the brains of patients with intracranial hypotension[10], findings include dural thickening and diffuse dural enhancement; engorgement and dilatation of venous structures; subdural fluid collections; downward displacement of the midbrain; and herniation of the cerebellar tonsils.

The case presented here demonstrates a chain of events that could have collectively resulted in the two central nervous system complications observed. The supratentorial surgical manipulation and the placement of the ventricular shunt could have caused intracranial hypotension, resulting in the traction, distension, and consequent rupture of cerebellar veins, as well as hemorrhage in the cerebellar parenchyma.

Radiologist knowledge of these entities is relevant, because their proper, early characterization can promote interventions aimed at their correction and at alleviating the associated symptoms.

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http://dx.doi.org/10.1590/0100-3984.2015.0089

Ultrasound guided injection of botulinum toxin into the salivary glands of children with neurological disorders

Dear Editor,

Here, we report the case of a 2-year-old male patient with corpus callosum atrophy who was under investigation for genetic syndrome. The patient had a gastrostomy and a permanent tracheostomy. He had sialorrhea (drooling) that had not responded to clinical treatment with sublingual atropine and had been hospitalized for pneumonia on multiple occasions. He was referred for ultrasound-guided injection of botulinum toxin—recommended for therapeutic use since 1822[1–7]—into the parotid and submandibular glands.

Ultrasound studies of the parotid and submandibular glands, all conducted by the same physician (with 15 years of experience in ultrasound), revealed that the glands were normal in appearance. Prior to, 30 days after, and 60 days after injection of the botulinum toxin, the glands were measured and their volumes were calculated. Ultrasound guidance allowed the best site for injection of the botulinum toxin to be identified, which prevented the toxin affecting structures adjacent to the salivary glands, such as the muscles involved in swallowing and vascular structures (Figure 1).

In follow-up visits, the mother reported that there was a significant decrease in the number of pads used for cleaning drool and a 50% reduction in the number of tracheal aspirations, without any complaints suggesting that the botulinum toxin had provoked an inflammatory process. The patient had no episodes of bronchopneumonia during the two-months observation period. The ultrasound studies of the parotid and submandibular glands showed no parenchymal changes subsequent to injection of the botulinum toxin.

The use of ultrasound to guide botulinum toxin injections is important in pediatric patients, especially because the small size of the salivary glands makes them difficult to palpate in such patients. In neurologically impaired children, the use of the ultrasound guidance is even more relevant, because they can present with increased muscle tone and often have a tracheostomy in an

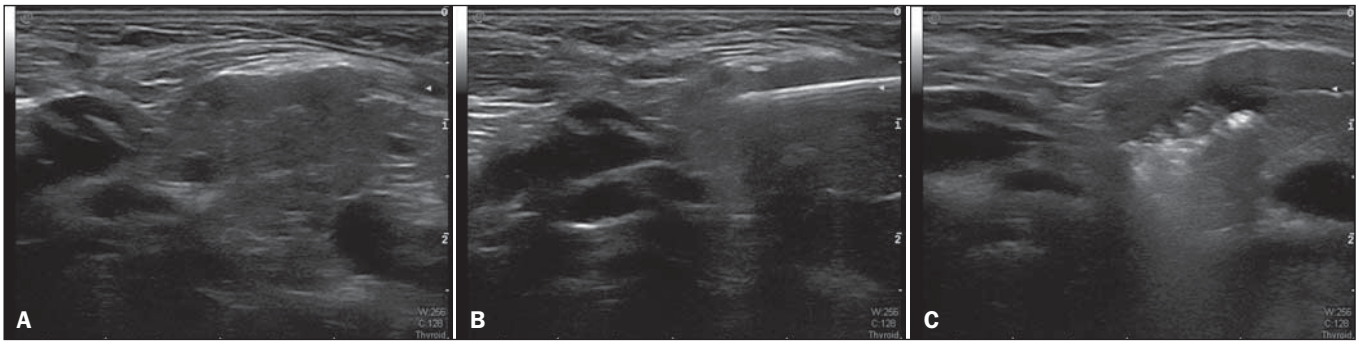

Figure 1. A: Normal right submandibular gland. **B:** Needle inserted into the gland. **C:** Botulinum toxin within the gland.

anatomically narrow location, as well as showing anatomical abnormalities[1]. In addition, the injection of botulinum toxin into adjacent structures could have undesirable effects, such as paralysis of the muscles involved in swallowing, which would worsen dysphagia[1].

Previous studies have demonstrated that injection of botulinum toxin into the salivary glands does not cause any histological alterations—only lymphocyte infiltration, which results in homogeneous shrinkage of the gland without atrophy[7]. In addition, multiple injections of botulinum toxin over time can cause atrophy of the submandibular glands, thus promoting a permanent reduction in the severity of sialorrhea[6]. In the case presented here, we observed a reduction in the volume of all of the salivary glands injected, except the right parotid. We speculate that the injection was ineffective in that gland and that there was an increase in the volume of the gland through vicarious mechanisms. The study of glandular volume in such cases is groundbreaking, and our group is contemplating further studies in this line of reasearch. In the literature, we found no articles comparing glandular dimensions before and after botulinum toxin injection in neurologically impaired children. A study conducted by Cardona et al.[8] showed no differences in glandular dimensions between children with and without sialorrhea. We seek to disseminate the knowledge that ultrasound guidance makes the injection of botulinum toxin into the salivary glands safer and more precise, especially in pediatric patients, as well as that ultrasound represents a noninvasive method of evaluating changes in the volume of those glands over time.

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http://dx.doi.org/10.1590/0100-3984.2015.0056