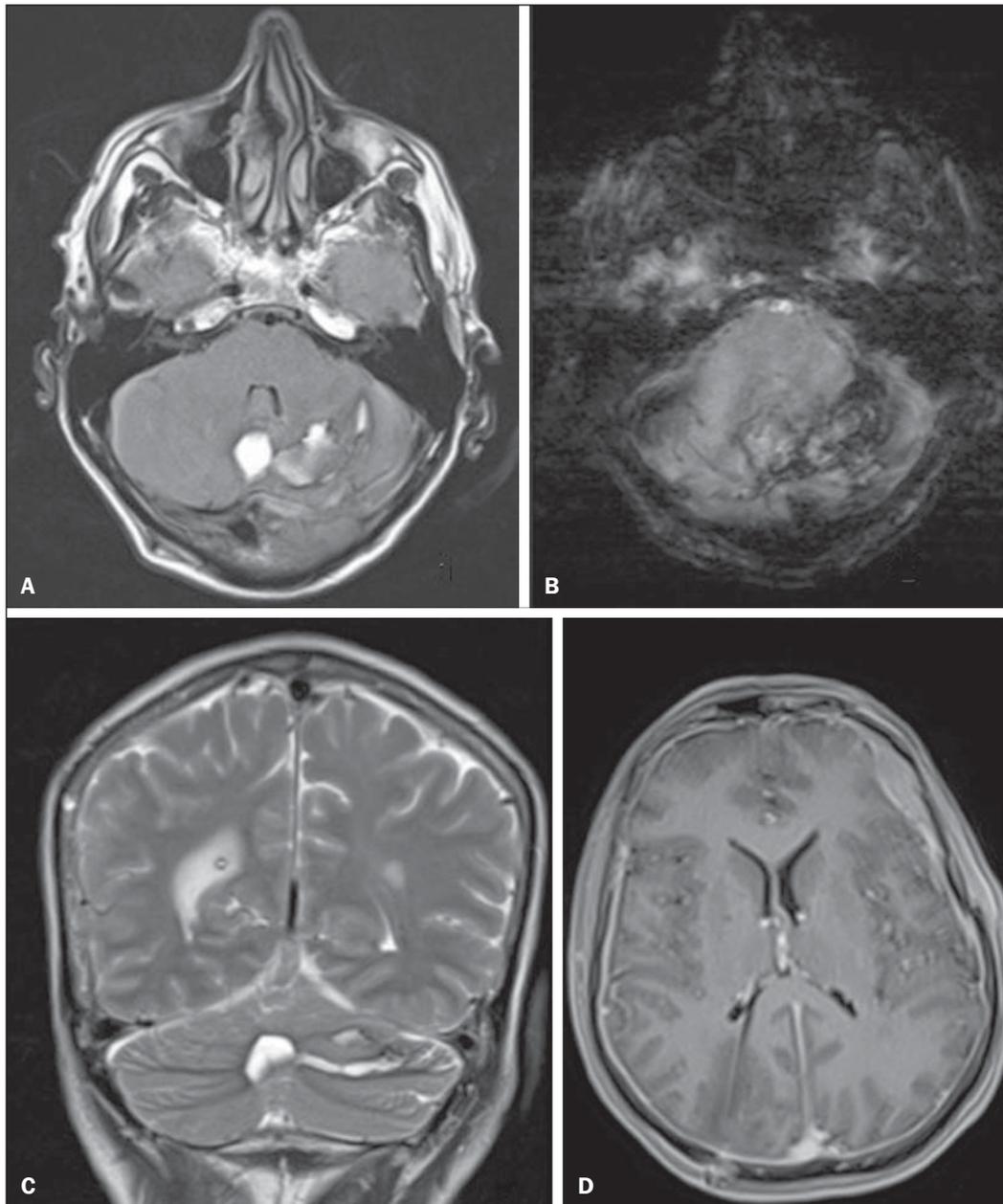


**Remote cerebellar hemorrhage and intracranial hypotension syndrome following pituitary surgery**

Dear Editor,

A 62-year-old male presented with a several-month history of headache and alteration in his visual field. The diagnostic evaluation revealed a suprasellar mass that was causing hydrocephalus by extrinsic compression. We opted for ventricular shunt placement and subsequent surgical excision of the mass. The surgical site was accessed through left frontal craniotomy. Histological analysis of the resected mass revealed that it was a craniopharyngioma.

In the postoperative period, the patient evolved to significant worsening of the headache, and a magnetic resonance imaging scan was requested in order to evaluate the condition. The magnetic resonance imaging showed cerebellar hemorrhage affecting the vermis and the left cerebellar hemisphere (Figure 1A), with standard distribution of blood among the cerebellar folia (Figures 1B and 1C), indicative of remote cerebellar hemorrhage. There were also signs suggestive of a loss of cerebrospinal fluid (intracranial hypotension syndrome), such signs including a decrease in the size of the ventricles, dural thickening, diffuse dural enhancement, and hematic left frontal subdural fluid collection (Figure 1D).



**Figure 1.** MRI scans of the cranium. **A:** FLAIR sequence in the axial plane, showing foci of hyperintense signals in the vermis and the left cerebellar hemisphere, which is consistent with cerebellar hemorrhage. **B:** SWI sequence in the axial plane, showing marked hypointensity indicative of hemoglobin degradation products (e.g., hemosiderin), with the zebra sign (pattern of distribution among the cerebellar folia). **C:** T2-weighted TSE sequence in the coronal plane, confirming cerebellar hemorrhage, in the different phases of hemoglobin degradation, with alternating areas of hyperintense and hypointense signals (the zebra sign). **D:** T1-weighted SE sequence in the axial plane after intravenous injection of paramagnetic contrast, showing the terminus of the ventricular shunt catheter at the trigone of the right lateral ventricle. Note the small size of the lateral ventricles, together with the marked dural thickening and significant dural impregnation, as well as the hematic left frontal subdural fluid collection. This combination of findings suggests a loss of cerebrospinal fluid (intracranial hypotension syndrome).

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.<sup>(1)</sup>. The reported incidence of remote cerebellar hemorrhage after supratentorial interventions ranges from 0.08% to 0.6%<sup>(2)</sup>. However, it has been reported to occur after various other surgical procedures involving the cranium or spinal cord<sup>(2-7)</sup>.

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<sup>(8)</sup>. 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<sup>(9)</sup>.

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<sup>(2-7,9)</sup>. 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<sup>(8)</sup>.

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<sup>(10)</sup>, 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.

#### REFERENCES

1. Yasargil MG, Yonekawa Y. Results of microsurgical extra-intracranial arterial bypass in the treatment of cerebral ischemia. *Neurosurgery*. 1977;1:22-4.
2. Bokhari R, Baeesa S. Remote cerebellar hemorrhage due to ventriculoperitoneal shunt in an infant: a case report. *J Med Case Rep*. 2012; 6:222.
3. Honegger J, Zentner J, Spreer J, et al. Cerebellar hemorrhage arising postoperatively as a complication of supratentorial surgery: a retrospective study. *J Neurosurg*. 2002;96:248-54.
4. Smith R, Kebriaei M, Gard A, et al. Remote cerebellar hemorrhage following supratentorial cerebrovascular surgery. *J Clin Neurosci*. 2014; 21:673-6.
5. Suzuki M, Kobayashi T, Miyakoshi N, et al. Remote cerebellar hemorrhage following thoracic spinal surgery of an intradural extramedullary tumor: a case report. *J Med Case Rep*. 2015;9:68.
6. Biasi PR, Mallmann AB, Crusius PS, et al. Hemorragia cerebelar remota como complicação de cirurgia de coluna vertebral. Relato de dois casos e revisão da literatura. *J Bras Neurocir*. 2011;22:66-71.
7. Paola L, Troiano AR, Germiniani FMB, et al. Cerebellar hemorrhage as a complication of temporal lobectomy for refractory medial temporal epilepsy: report of three cases. *Arq Neuropsiquiatr*. 2004;62:519-22.
8. Amini A, Osborn AG, McCall TD, et al. Remote cerebellar hemorrhage. *AJNR Am J Neuroradiol*. 2006;27:387-90.
9. Chalela JA, Monroe T, Kelley M, et al. Cerebellar hemorrhage caused by remote neurological surgery. *Neurocrit Care*. 2006;5:30-4.
10. Savoirdo M, Minati L, Farina L, et al. Spontaneous intracranial hypotension with deep brain swelling. *Brain*. 2007;130(Pt 7):1884-93.

**Luiz de Abreu Junior<sup>1</sup>, Henrique T. Martucci<sup>2</sup>, Paulo Tarso Reck de Mendonça<sup>3</sup>, Gustavo Garcia Marques<sup>2</sup>, Célia Rodrigues<sup>1</sup>**

1. Universidade São Camilo, São Paulo, SP, Brazil. 2. Clínica São Camilo, Sinop, MT, Brazil. 3. Instituto Neurocirúrgico de Sinop, Sinop, MT, Brazil. Mailing address: Dr. Luiz de Abreu Junior. Rua Baturité, 200, ap. 32B, Aclimação. São Paulo, SP, Brazil, 01530-030. E-mail: abreu\_jr@terra.com.br

<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<sup>(1-7)</sup>—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 in-

jection 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