# CEREBELLAR HEMORRHAGE AS A COMPLICATION OF TEMPORAL LOBECTOMY FOR REFRACTORY MEDIAL TEMPORAL EPILEPSY

## Report of three cases

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ABSTRACT - Cerebellar hemorrhage is listed among the potential complications following neurosurgical procedures. In this scenario it is usually reported as a rare condition. However, it seems that epilepsy surgery patients are somewhat more prone to this kind of complication, compared to other surgical groups. Head positioning, excessive cerebral spinal fluid draining and the excision of non-expanding encephalic tissue (or combinations among the three) are likely to be cause underlying remote cerebellar hemorrhage. Out of the 118 ATL/AH performed at our institution, between 1996 and 2002, we identified 3 (2.5%) patients presenting with cerebellar hemorrhage. We report on such cases and review the literature on the topic.

KEY WORDS: cerebellar hemorrhage, epilepsy surgery, neurosurgical complications.

**Hemorragia cerebelar como complicação de lobectomia temporal para epilepsia do lobo temporal medial: relato de três casos**

RESUMO - A hemorragia cerebelar faz parte das potenciais complicações dos procedimentos neurocirúrgicos. De forma geral, é considerada uma condição rara. Entretanto, há aparente propensão dos pacientes submetidos ao tratamento cirúrgico de epilepsia em apresentar este tipo de complicação, quando comparados com outros grupos cirúrgicos. O posicionamento da cabeça, excessiva drenagem de líquido cefalorraquidiano e a excisão de tecido cerebral não expansível (ou talvez combinações entre os três) constituem as potenciais causas da hemorragia cerebelar remota. Entre os 118 pacientes em nossa série de LTA / AH, identificamos 3(2.5%) casos de hemorragia cerebelar. Relatamos os três casos desta natureza, com revisão da literatura pertinente a esta complicação.

PALAVRAS-CHAVE: hemorragia cerebelar, cirurgia de epilepsia, complicações neurocirúrgicas.

Anterior temporal lobectomy (ATL) and amygdalohippocampectomy (AH) are effective treatment alternatives in patients with temporal lobe epilepsy refractory to medical treatment. Neuropsychological disturbances (language and memory) are the most common post-operatory derangements. Nevertheless, surgical complications are rarely expected, both locally and at remote sites. Recent papers have shed some light on the relative high frequency of cerebellar hemorrhage in patients submitted to anterior temporal lobectomy, when compared to other surgical groups. It seems that ATL/AH patients are particularly prone to this kind of complication. At our institution ATL / AH are always performed using the same surgical technique (that is, a trans-temporal approach). Out

of the 118 ATL / AH performed at our institution we were able to identify 3(2.5%) patients presenting with cerebellar hemorrhage. Their cases are reported.

### CASES

*Patient 1.* A 31 year-old male patient, presenting with a seizure disorder starting at the age of 9 y/o, characterized by an aura (epigastric sensation), shortly followed by a complex partial seizure and on occasion a generalized tonic-clonic seizure. He was tried on phenobarbital and carbamazepine, with unsatisfactory seizure control. A combination of valproic acid, phenytoin and clobazam ultimately led to control of the secondarily generalized seizures. The complex partial seizures still occurred many times per week. Physical and neurological examinations were normal. An electroencephalogram (EEG)

showed left temporal interictal spikes and a brain magnetic resonance image (MRI) disclosed left hippocampal atrophy, consistent with the diagnosis of mesiotemporal sclerosis (MTS). During videoeletroencephalographic (VEEG) monitoring, 3 complex partial and 1 secondarily generalized seizures were recorded from the left mesiotemporal lobe.

He was then admitted to undergo left ATL. There were neither metabolic nor coagulation disorders, as verified by normal platelets count and PT / aPTT values. While supine with his head turned to the right, the patient underwent a craniotomy for a left 3 cm ATL and 3.5 cm AH. At the end of the surgery, a subgaleal suctor drain was placed. Pathology was confirmatory of hippocampal sclerosis.

In the immediate post-operatory (PO) period, he was observed in the Intensive Care Unit (ICU) with an initial Glasgow Coma Scale (GCS) of 10. On the second day at the ICU he was still judged as "unusually drowsy and dysarthric". On the 3rd PO day a brain computed tomography (CT) scan disclosed multiple foci of cerebellar hemorrhage, predominantly on the right cerebellar hemisphere, but no surgical drainage was necessary (Fig 1). A cerebral angiographic study was normal.

In the 9th PO day the patient developed a liquoric fistula and fever. A cerebrospinal fluid (CSF) study showed 21 red cells/mm$^3$, 7680 leucocytes/mm$^3$, 80% neutrophils, glucose 1mg/dL and proteins 404mg/dL. He was put on cefepime for 14 days, after which CSF showed 58 red cells/mm$^3$, 19 leucocytes/mm$^3$, 87% lymphocytes, glucose 39 mg/dL and proteins 124 mg/dL. He was discharged on the 24th PO day, without significant coordination impairment and later returned in the outpatient clinic for reevaluation of his seizures. He remained seizure-free on antiepileptic drugs (AEDs) for approximately twelve months, after which he experienced seizure recurrence. Drug adjustments were unsuccessful. A follow-up CT scan performed on the 28th PO day showed resolution of the hemorrhage on both cerebellar hemispheres.

*Patient 2.* A 37 year-old female patient with a seizure disorder starting at the age of 13 y/o, consisting of complex partial seizures with frequent secondary generalization. Her best AED combination was sodium valproate and carbamazepine, when she presented with complex partial seizures 2 to 3 times per week and infrequent secondarily generalized seizures. Other combinations or a regime including higher doses invariably lead to intolerable side effects. Past and familial history were unremarkable. EEG disclosed right temporal inter-

ictal epileptiform discharges. Brain MRI showed right hippocampal atrophy consistent with MTS. She was submitted to VEEG and two of her typical complex partial seizures were recorded from the right temporal lobe.

She then underwent right ATL. Pre-operative metabolic and coagulation studies were normal. While supine with her head turned to the left, a right craniotomy was performed for right ATL and AH, using the vein of Labbé as the posterior margin for the resection, that is, approximately a 6cm resection from the temporal tip . At the end of the surgery, a subgaleal suctor drain was placed.

After surgery, consciousness recovery was normal and she presented with no deficits. In the 2nd PO day, the patient presented with headache, nausea and vomiting. Fundoscopy was normal, as well as, motor and coordination tests. Brain CT scan showed laminar right hemisphere cerebellar hemorrhage (Fig 2). A neurosurgery consult was requested and the option was for clinical treatment. The patient received analgesic and antiemetic treatment and was discharged four days later. At discharge she was asymptomatic with a normal physical and neurological exam. A control CT scan performed on the 4th PO day showed partial resolution of the hemorrhage.

*Patient 3.* This is a 38 year-old male patient, presenting with a seizure disorder starting at the age of 7 y/o, characterized by an aura ("light-headedness" sensation), shortly followed by a complex partial seizure with secondarily generalization. He was tried on phenytoin, valproic acid, lamotrigine, clobazam and clonazepam, with unsatisfactory seizure control. A combination of carbamazepine and phenobarbital led to a better control of the generalized seizures, whereas complex partial seizures still occurred monthly, usually in clusters of up to four seizures a day. Physical and neurological examinations were normal. An EEG showed left temporal interictal spikes and a brain MRI disclosed left hippocampal atrophy, consistent with the diagnosis of MTS. During VEEG monitoring, 6 complex partial seizures were recorded from the left mesiotemporal lobe.

He was then admitted to undergo left ATL. There were neither metabolic nor coagulation disorders. While supine with his head turned to the right, the patient underwent a craniotomy for a left 3 cm ATL and 3.5 cm AH. A subgaleal suctor drain was placed.

At the ICU, in the immediate PO, he presented with a GCS of 8, aphasic and had a generalized tonic-clinic seizure. Diazepam 5 mg was administered intravenously, as well as, a bolus of manitol, with improvement of consciousness. A skull CT scan disclosed laminar
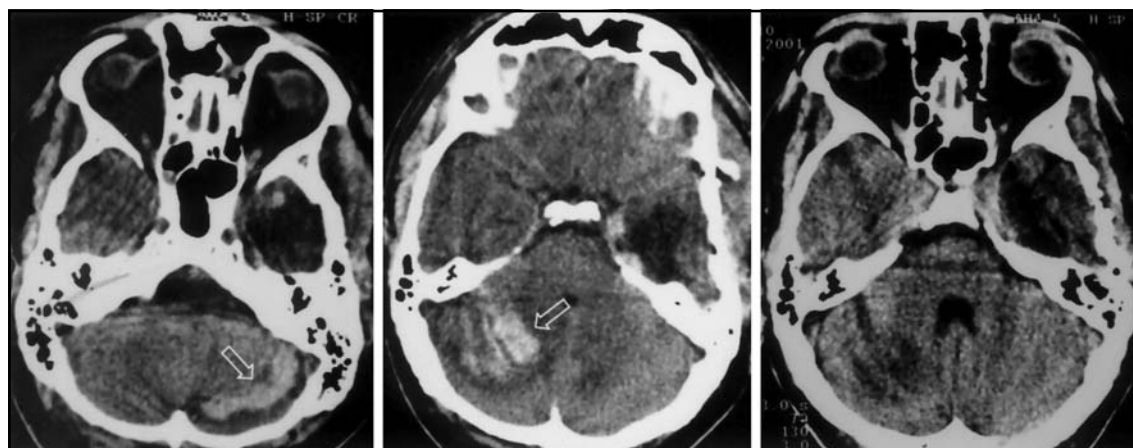


*Fig 1. Patient 1: bilateral cerebellar hemorrhage.*

*Fig 2. Patient 2: laminar right cerebellar hemisphere hemorrhage.*



*Fig 3. Patient 3: bilateral cerebellar hemorrhage, more prominent on the left hemisphere.*

cerebellar hemorrhage, more prominent on the left cerebellar hemisphere (Fig 3). Once again, no surgical drainage was necessary. On the 7th PO day he was discharged, with no further cerebellar signs. He later returned in the out-patient clinic for reevaluation of his seizures and he has remained seizure-free on AEDs for seven months. A follow-up CT scan was obtained on the 30th PO day, showing good resolution of the cerebellar hemorrhage.

## DISCUSSION

Although infrequent, cerebellar hemorrhage may be a potential complication following neurosurgical interventions. Nevertheless, its development at a distant site from the operative incision is definitively a rare situation to which attention has been drawn only in the past few years. In a retrospective survey of 4992 intracranial procedures, Kalfas and Little[1] found 40 patients (0.8%) to present hemorrhages, 33 of them at the operative site (intracerebral, epidural, subdural or intrasellar) and 7 at a distant location. The most common etiology that led to surgical treatment was brain tumor in 56%, with meningioma as the leading pathological type.

A group analysis of 37 cases of remote intracerebral hemorrhage conducted by Brisman et al.[2] (5 patients from their own series and 32 reviewed from the literature) included supratentorial hemorrhages in infratentorial craniotomies and the reverse. Seventy-eight percent of patients had symptoms suggestive of acute intracranial hypertension in the first few hours after surgery. In the setting of infratentorial hemorrhage, 81% of the patients underwent access through the deep sylvian fissure and paraclinoid regions. The cerebellar vermis was the focus in 67%. Such derangements were not related to hypertension, coagulopathies or the volume of cerebrospinal fluid drainage. Fourteen percent of patients from this heterogenic sample were disabled, and 32% died.

The specific concern of cerebellar hemorrhage after epilepsy surgery is illustrated by the reports of Toczek et al. and Yacubian et al. The former presented four patients treated with ATL and/or AH who presented uni or bilateral cerebellar hemorrhage 1 to 4 days after surgery[3]. Blood pressure, platelets count and coagulation were normal in all patients except for one, promptly treated with anti-hypertensive drugs. Varying amounts of cerebrospinal fluid drained in the PO period (215 to 525mL) was reported as the only potentially implicated factor. One patient had a ventricle drain placed to compensate hydrocephalus, the others needed nothing but conservative measures. All of them had normal neurological examinations at one month follow-up. A series of three patients submitted to ATL/AH found similar results both on patient profile and clinical outcome. One patient did not have his lateral ventricles opened or a suctor drain in the post-operative period[4].

Doubt about the timing of cerebellar hemorrhage, whether intra or post-operatory, was fed by discordant data on patients who did not recover consciousness after surgery and those who, after awaking from anesthesia, re-entered coma state or developed cerebellar signs. This issue was addressed by Honegger et al. with data from a neurosurgical institution in which all patients are routinely CT scanned in the first hour after surgery[5]. Of 1650 patients who undergone supratentorial craniotomy over a three-year period, 10 had cerebellar hemorrhage. Seven of these had been submitted to ATL/AH. In addition, out of the original ten, seven patients had an initial normal CT scan, an indicator that posterior fossa bleeding appeared over the next few hours following surgery (mean time for diagnosis: 7

hours and 35 minutes).

Systemic hypertension, the top-ranking etiologic factor of spontaneous cerebellar hemorrhage, is not related to this entity. Apparently, the same applies to coagulation disorders and anticoagulant treatment. Sodium valproate was once blamed as a cause to peri-operatory excessive bleeding, but even this remote cause has been recently questioned in the literature[6].

Positioning of the patient during surgery might play a secondary role in increasing venous pressure over the posterior fossa. Seoane and Rhoton[7], in an elegant microsurgical anatomical study in adult cadaveric specimens, showed unilateral jugular compression, to the point of occlusion, by transverse process of C1 when the head is turned contralateraly. That perhaps would be sufficient explanation if remote cerebellar hemorrhage was secondary to virtually any surgical access based on head tilting, which certainly does not hold true on neurosurgical routine. Nevertheless, we still lack a better hypothesis, since evidence shows that most supratentorial approaches other than epilepsy surgery do not present with cerebellar bleeding. Plus, according to Kalfas and Little, the recumbent position does not seem safer than the sitting position in preventing posterior fossa bleeding[1].

The most accepted theory to date underlying remote cerebellar hemorrhage is an association between liquor overdraining and the excision of non-expanding encephalic tissue. ATL/AH is commonly carried out with opening of lateral ventricles and subsequent CSF flow. Intracranial drains and suctors are part of the post-operative protocol in various institutions. Moreover, removal of a brain tumor would cause supratentorial pressure to return to near normal values, but lobectomy is an adjunct factor to create a gradient between supra and infratentorial compartments. Such pressure gradient may act as a suction mechanism over the cappilary veins of cerebellum, which are then traumatized, leading to intraparenquimatous bleeding[4,5]. The association of fluid overdraining and removal of non-tumorous tissue is specially prone to happen in epilepsy surgery, and this might be the reason why such complication is infrequently seen involving other neurosurgical approaches.

In conclusion, cerebellar hemorrhage in post-operative supratentorial craniotomy for epilepsy surgery constitutes a rare complication and its physiopathology is yet to be entirely understood. Some patients may not even present with clear symptomatology, and hyperdense signals on posterior fossa may be an occasional finding in follow-up CT studies. Treatment of such complication is similar to that of nontraumatic cerebellar hematomas and must be individualized. Most cases are associated with an excellent outcome.

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