Remote Cerebellar Hemorrhages

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Abstract

Remote cerebellar hemorrhage is a rare complication of a variety of neurosurgical procedures, mainly supratentorial craniotomies, which occur frequently distant to the site of surgery. The precise mechanisms by which remote cerebellar hemorrhage occurs are unknown; however, two facts are known: it is of venous origin and is the result of intra- and postoperative loss of cerebrospinal fluid. Non-enhanced CT is the modality of choice and shows superficial linear hyperdense bleeds in the superior surface of the cerebellar hemispheres. Although MRI is more sensitive than CT in detection of small hemorrhages, this does not affect treatment, and therefore, MRI is not the first modality of choice to image patients in which this condition is suspected.

Background

Remote cerebellar hemorrhage (RCH) is a rare complication of a variety of neurosurgical procedures, mainly supratentorial craniotomies, which occur distant to the site of surgery [1, 2].

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RCH is more common between the ages of 30 and 60 years [1]. Common presenting symptoms of RCH are prolonged awakening from anesthesia, decreased level of consciousness, motor deficits, and gait ataxia [3]. However, RCH is frequently asymptomatic; consequently, it is probably under-recognized and underreported [4]. Authors report RCH after 0.6 % of all supratentorial craniotomies, 3.5 % after surgical repair of ruptured anterior communicating artery aneurysms, and 5 % after temporal lobectomies [5, 6]. It can also be a rare complication of spinal surgery [2].

Treatment is generally conservative or may be surgical (external ventricular drainage, hematoma evacuation, and suboccipital decompression). Treatment depends on the patient's

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condition and the degree of mass effect by the hematoma [4, 7].

Key Points

Etiology

The precise mechanisms by which cerebellar hemorrhage occurs are unknown; however, male sex, perioperative hypertension, and preoperative usage of anticoagulation are risk factors [1]. However, no specific etiological factors have been identified although most authors agree on two facts regarding RCH [4, 7].

- RCH is of venous origin.
- RCH is a result of intra- and even more likely postoperative loss of cerebrospinal fluid (CSF).

But despite the agreement that loss of CSF is an underlying reason for RCH, no consensus regarding the exact mechanisms has been reached. Some authors have suggested that it may be due to mechanical forces (shearing of cerebellar bridging veins) or hemodynamic causes (increase in venous blood pressure) [1, 2, 4]. Friedman et al. proposed that opening of cisterns and of the ventricular system causes CSF hypovolemia resulting in cerebellar sagging. This causes transient occlusion of the superior bridging veins in the posterior fossa leading to subsequent hemorrhagic infarction [5].

Best Imaging Modality

Non-enhanced computed tomography (*CT*). It is the modality of choice and shows superficial linear hyperdense areas related to hemorrhage in the cerebellum. These bleeds follow the configuration of the folia and fissures and have often been called "zebra stripes."

Other Imaging Techniques

Magnetic resonance imaging (*MRI*). Since MRI is more sensitive than CT in the evaluation of the posterior fossa, it can show smaller hemorrhages [8]. Because small amounts of blood and their localizations do not affect treatment, MRI is not the first modality of choice to image patients suspected of having RCH. When it is performed, findings vary with the age of the hematoma. Gradient-recalled echo (GRE) and susceptibility-weighted image (SWI) demonstrate "blooming effect" and make identification of hemorrhages easier [4].

Conventional catheter digital angiography is usually normal [4].

Major Findings

RCH is commonly bilateral (53.5 %) or unilateral (46.5 %). In CT, the classic associated bleeding pattern includes superficial blood extension into the subarachnoid space of the cerebellar fissures/folia and vermis, producing alternating hyperdense (blood) and hypodense (cerebellum) curvilinear slightly irregular stripes that are similar to a zebra's coat and gave the "*zebra sign*" its name (Figs. 8.1 and 8.2). Hemorrhages that are somewhat irregular rather than purely curvilinear should raise the question of whether there could be a deeper intraparenchymal component. Additionally, *intracerebellar hemorrhage*, mainly in the upper parts of the cerebellum, may be observed [2, 8, 9]. The "zebra sign" can also be seen on MRI (Fig. 8.3).

It is important to establish the amount of blood as the bleed may be large enough to cause mass effect, leading to cerebellar herniation and obstructive hydrocephalus [1].

Imaging Follow-Up

Small bleeds with little or no mass effect seem to be self-limiting and do not require further work-up in the face of clinical stability. If follow-up is indicated, CT is helpful in assessing the evolution of the bleeds [1, 4].

Main Differential Diagnosis

It is important to recognize this type of hemorrhage in a postsurgical state as an apparently sequela of surgery rather than as a result of

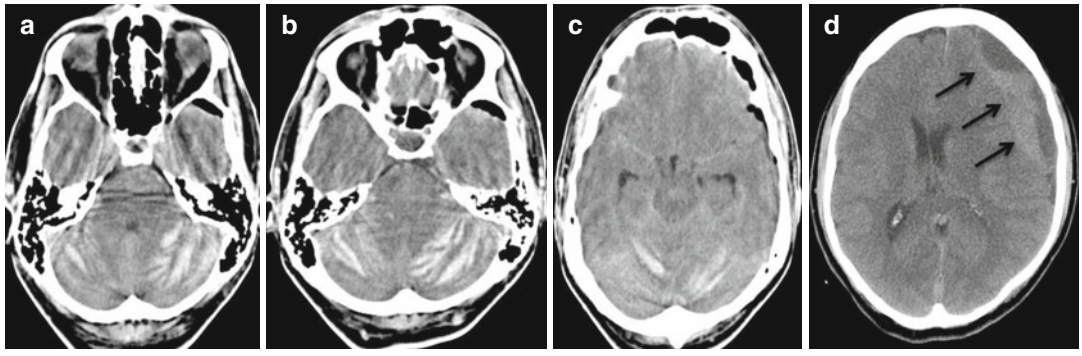

Fig. 8.1 Remote cerebellar hemorrhage post-craniotomy. (**a**–**c**) Non-enhanced CT depicts blood with curvilinear stripe appearance called "zebra sign" in the cerebellum. The patient developed this complication after surgical treatment of subdural hematoma (*black arrows* in **d**) (Courtesy of Sonia Bermudez MD, Bogotá – Colombia)

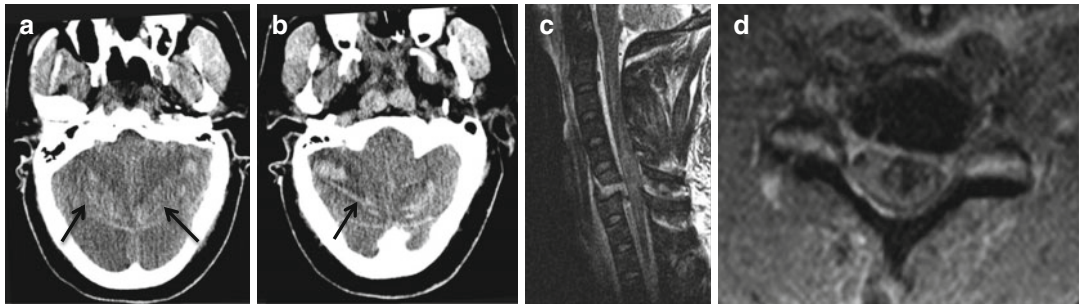

Fig. 8.2 Remote cerebral hemorrhage in a patient with recent spinal surgery. (**a**, **b**) Non-enhanced CT in two different levels shows blood in the posterior fossa with curvilinear and irregular hyperdense stripes, compatible with the "zebra sign" (*arrows*). (**c**, **d**) Sagittal and axial T2WI show C6–C7 dislocation with spinal cord injury and a hemorrhagic pattern. After surgery for stabilization, the patient developed RCH

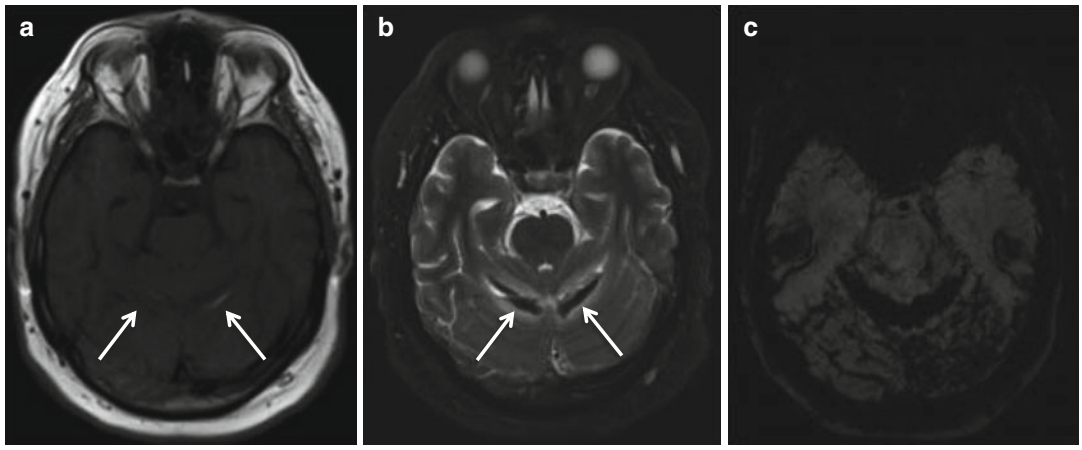

Fig. 8.3 "Zebra sign" in MRI. Patient with RCH after supratentorial craniectomy. (**a**) Axial TIWI and (**b**) axial T2WI show subacute hemorrhage with stripe appearance in the cerebellum (*arrows*). (**c**) SWI showing "blooming" effect and hemorrhages better seen

arterial hypertension, previously unrecognized vascular malformation, neoplasm, or subarachnoid bleeding from a ruptured aneurysm [8]. However, ruptured vascular malformations in the cerebellum may result in hemorrhages of similar appearance but such patients have no history of prior surgery.

Other postsurgical complications, such as *sinus venous thrombosis* leading to venous infarcts, should be considered in the differential diagnosis.

Tips

- Patients with unexplained and severe headaches, acute confusion, lethargy, and ataxic symptoms postoperatively should immediately undergo head CT.
- "Zebra sign" is the classical appearance of RCH in a patient with worsening neurological status after surgery.
- Establishing the size of the bleeds and degree of hydrocephalus has important prognostic value.
- Immediately report mass effect and possible cerebral herniation to allow for rapid intervention.

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