

# IMAGING FINDINGS OF REMOTE CEREBELLAR HEMORRHAGE AFTER SURGICAL OBLITERATION OF A SPINAL DURAL ARTERIOVENOUS FISTULA

## Case Report

## SPİNAL ARTERİOVENÖZ FİSTÜLLERİN CERRAHİ OBLİTERASYONUNDAN SONRA GELİŞEN UZAK SEREBELLAR KANAMADA GÖRÜNTÜLEME

## Olgu Sunumu

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## ABSTRACT

### Introduction

Hemorrhage around the operative site is common following neurosurgical procedures. And also hemorrhage at remote sites such as epidural, subdural or subarachnoid spaces is also not uncommon. But cerebellar hemorrhage after supratentorial neurosurgical operations is a rare, self-limiting phenomenon. And lots of cases have been reported in the neurosurgical literature. But, to the best of our knowledge, remote cerebellary hemorrhage after spinal arteriovenous fistula (DAVF) repairing operation has not been described with imaging findings in the literature previously.

### Case Report

A 46-year-old woman with dorsolumbar non-radicular pain whom had a type I spinal DAVF underwent neurosurgical operation under general anesthesia is presented. She was discharged from the intensive care unit with no early postoperative complication. A few days later, she had a severe headache, visual disturbance and confusion. A control cranial MRI examination had to be done with the prediagnosis of intracranial hypotension. At the MRI, there were bilaterally cerebellary hemispheric fusiform hemorrhages which confirmed on conventional sequences. Neither an underlying lesions were identified nor any enhancement was seen on the postcontrast T1-weighted MR images. Control CT myelography confirmed lumbar CSF fistula formation. At 3-month follow-up, CSF fistula formation had been resolved spontaneously and the patient had no symptoms or neurologic deficits.

### Conclusion

RCH (remote cerebellar hemorrhage) is an alarming but seldom reported complication of supratentorial craniotomies. With this unique case which present RCH after spinal DAVF operation, support the hypothesis of cerebellar sagging due to CSF hypovolemia. But RCH is also a self-limiting phenomenon, and further surgical or diagnostic invasive evaluation directed to the secondary affected area (cerebellum for our case) is not required.

**Key words:** *Cerebellar hemorrhage; Dural arteriovenous fistula; Spinal.*

## ÖZET

### Giriş

Nöroşirurjik işlemlerde operasyon loju çevresinde kanama meydana gelmesi nispeten siktir. Aynı zamanda bu operasyonlardan sonra; epidural, subdural, subaraknoid boşluklarda da kana rastlanması nadir değildir. Supratentorial girişimlerden sonra, kendi kendini sınırlayan bir fenomen olan serebellar kanama ise nispeten nadirdir. Bu gibi olgular literatürde çok sayıda bildirilmiştir. Fakat, araştırdığımız kadarı ile, literatürde, görüntüleme bulguları ile birlikte sunulmuş, spinal dural arteriovenöz fistül (DAVF) tamirinden sonra gelişmiş uzak serebellar hematoma olgusu bildirilmemiştir.

### Olgu sunumu

Bu olgu sunumunda, 46 yaşında, nonradiküler bir dorsolomber ağrı ile başvuran ve incelemelerde tip I spinal DEVF'e sahip olduğu anlaşılan ve genel anestezi eşliğinde opere edilen bir bayan çalışmaya dahil edilmiştir. Olgu, devamlı bakımdan herhangi bir erken postoperatif komplikasyon gelişmeksizin çıkarılmıştı. Normal üniteye iken, bir kaç gün sonra görme bozukluğu ve konfüzyonun eşlik ettiği şiddetli bir başağrısı gelişmişti. İntrakranial hipotansiyon öntansı ile acil bir kontrol kranial manyetik rezonans görüntüleme (MRG) gerçekleştirildi. Bu incelemede, konvansiyonel sekanslarda bilateral serebellar hemisferik fuziform ince hemorajiler geliştiği tespit edildi. MRG incelemede, altta yatan bir lezyon veya kontrast tutulumu tespit edilmedi. Kontrol bilgisayarlı tomografi (BT) miyelografide, dural beyin omurilik sıvısı (BOS) kaçağı tespit edildi. Üç aylık takipten sonra, BOS kaçağı spontan olarak ortadan kalktı. Hastanın semptomları ve nörolojik defisit ortadan kalkmıştı.

### Sonuç

Uzak serebellar kanama (USK), nadiren gelişen ancak farkın avarılması gereken, bildirilmiş olgularda da genelde supratentorial kraniotomilerden sonra gelişmiş bir komplikasyondur. Bu özel olgu ile, biz, USK'nın, spinal DAVF operasyonundan sonra gelişmesi; BOS hipovolemisi ile serebellumun

aşağıya doğru sağılması teorisinin de ispatını yapmış bulunmaktayız. Bu gibi olgularda USK'nın kendi kendini sınırlar ve daha ileri radyolojik prosedür ya da cerrahi tedavi gerektirmez.

**Anahtar Kelimeler :** *Serebellar kanama; Dural arteriovenöz fistül; Spinal.*

## INTRODUCTION

Hemorrhage around the operative site is common following neurosurgical procedures. Hemorrhage at remote sites such as epidural or as subdural and sometimes as subarachnoid spaces is also not uncommon (1). Cerebellar hemorrhage (CH) after supratentorial neurosurgical operations is a rare, self-limiting phenomenon. Cerebellar hemorrhages are rarely reported in patients following supratentorial surgery, spinal surgery, and in patients with spontaneous intracranial hypotension. The mechanism is thought to be removal of large amounts of cerebrospinal fluid (CSF) or continuing CSF leak from dural breach. The hemorrhage is remote from the surgical site or anatomic defect and it may come from transient occlusion or rupture of superior cerebellar bridging veins (2,3).

Remote cerebellar hemorrhage (RCH) following supratentorial craniotomy, even after spinal surgery, is a very infrequent complication. The underlying pathophysiology of this subset of cerebellar hemorrhage is not clear yet, reviews and reports speculate around a venous origin, but perioperative or even more likely, postoperative loss of large volumes of cerebrospinal fluid (CSF) seems to be related to remote cerebellar hemorrhage (4). Whereas, hemorrhage from trauma, arteriovenous malformations, blood dyscrasias, amyloid angiopathy and tumors are less common causes of CH. In these instances, CHs result from the same causes as other intracerebral hemorrhages. Long-standing hypertension with degenerative changes in the vessel walls and subsequent rupture is believed to be the most common cause of a typical cerebellar hemorrhage (4,5). The relevance of patient positioning in the development of RCH is unclear. Head positioning, perioperative hypertension, lumbar drainage of cerebrospinal fluid (CSF), and postoperative epidural drainage have each been proposed to be relevant to the cause of remote cerebellar hemorrhage (4, 6).

Although lots of cases have been reported in the neurosurgical literature, to the best of our knowledge, remote cerebellary hemorrhage (RCH) after spinal arteriovenous fistula (DAVF) operations has not been described in the imaging literature.

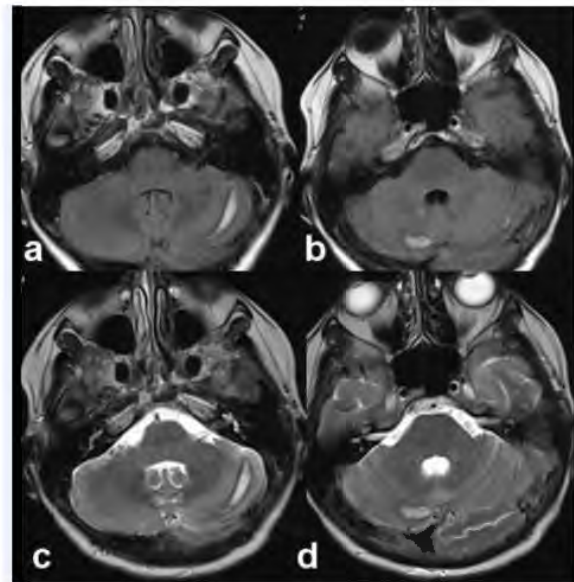
### CASE REPORT

A 46-year-old woman who has dorsolumbar non-radicular pain and has a type I spinal DAVF. She underwent neurosurgical operation (fistula repairing) under general anesthesia and she was discharged from the intensive care unit with no early postoperative complication. A few days later, because of visual disturbances and confusion with severe headache, cranial MRI examination had to be done with the prediagnosis of intracranial hypotension. With this method there were bilaterally cerebellary hemispheric fusiform hemorrhages which confirmed on conventional sequences (**Figure 1**).



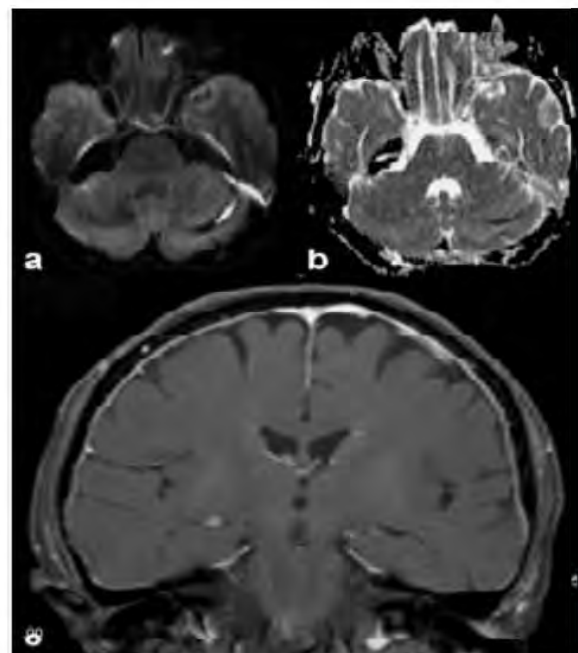
**Figure 1.** Saggital T2W (a), Coronal T1W (b), Magnified saggital T2W (c) and magnified axial T1W (d) images show the tubular, tortuous signal voids which have intramedullary and extramedullary components which represents arteriovenous malformation.

No enhancement was seen on the postcontrast T1-weighted MR image and no underlying lesions were identified (**Figure 2**).



**Figure 2.** Axial T1 (a, b) and T2-weighted (c, d) images show the left and right cerebellar hemisphere hemorrhages with no severe mass effect but with minimal adjacent edema.

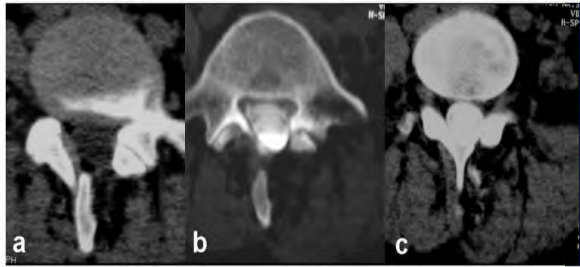
Diffusion was restricted due to hemorrhagic products. The leptomenigeal dural thickening and enhancement also has supported intracranial hypotension syndrome (**Figure 3**).



**Figure 3.a)** Axial diffusion-weighted and b) corresponding ADC map at the same section show the restriction due to artefacts from the hemorrhagic products. b) Coronal contrast enhanced T1W image shows prominent diffuse dural contrast enhancement

and moderate thickening (associated with hypotension).

At the control lumbar CT after injection of the intratechal non-ionic contrast agent confirmed mild dural ectasia at the operation site and CSF fistula formation at late phase images in this region (**Figure 4**).



**Figure 4.** Axial CT sections of the patients examined shortly after operation. a) Non-enhanced axial image shows the laminectomy defect area. b) After intratechal non-ionic contrast administration, expansion of the thecal sac at the defect site was seen at the CT taken immediate after the procedure. c) Late phase CT section shows extravasation of the contrast to the paravertebral soft tissues proves the CSF fistula formation.

At 3-month follow-up, the postoperative CSF fistula formation had been resolved spontaneously and the patient had no symptoms or ongoing neurologic deficits.

## DISCUSSION

Cerebellar hemorrhage remote from the operative site is one of the most serious but very rare complications of spinal surgery. Remote cerebellar hemorrhage has been reported less frequently after spinal surgery than after cranial surgery (4,7). It has been reported after a variety of neurosurgical procedures. It does not seem to be related to any specific type of surgery. It is a complication that is most common between the ages of 30 and 60 years. This phenomenon is rare in children (2,3). It is likely to be under-recognized and under-reported in the literature. Because RCH is frequently asymptomatic, it is likely that some patients with remote hemorrhage do not undergo postoperative imaging and the hemorrhage is never detected (8).

Cerebellar hemorrhage may occur as an intraoperative or postoperative event. The timing of the hemorrhage occurred is difficult to determine, because postoperative CT is generally not performed immediately after

surgery. Early postoperative and follow up CT or MRI indicated that cerebellar hemorrhage occurred as a postoperative rather than an intraoperative event (1, 5). In our case, MRI obtained a few days later after surgery demonstrated cerebellar hemorrhage, and follow-up MRI showed no progression of hemorrhage. Though these findings cannot demonstrate the time of occurrence.

The prognosis for patient with cerebellar hemorrhage is usually good and careful intraoperative and postoperative care, especially rapid overdrainage of CSF if suction drainage is used, is required to avoid this complication (1).

The most common presenting symptoms of RCH are headache, decreased level of consciousness, visual disturbance, motor deficits, gait ataxia, and prolonged awakening from anesthesia. Some cases are asymptomatic and found incidentally on postoperative CT or MR imaging (2,4). In our case, patient had a severe headache, confusion and visual disturbance. RCH can occur contralateral or ipsilateral to the site of craniotomy or may occasionally be bilateral (2,3). In our case, at the MRI, there were bilaterally cerebellary hemispheric fusiform hemorrhages.

RCH seems to be a self-limiting and identifiable complication of supratentorial craniotomies and spinal surgeries. Location and size of the bleed may have an important prognostic value. If the bleed is large enough to cause mass effect leading to obstructive hydrocephalus, surgical intervention may be indicated (3,4). In our case, no further work-up or intervention.

The most likely cause of cerebellar hemorrhage during supratentorial surgery is drainage of the cerebrospinal fluid (CSF) which results in the formation of a cerebellar "sag". This mechanism causes transient occlusion of the superior bridging veins, which leads to hemorrhagic venous infarction. There is a growing consensus that hemorrhagic venous infarction underlies most cases of RCH. It is possible that downward cerebellar displacement, or "sag," resulting from intraoperative loss of CSF causes transient stretch occlusion of superior cerebellar veins draining in the cephalad direction into the deep venous system (3,5,8). Excessive drainage of CSF causes intracranial hypotension, which may lead to a critical increase in the

transluminal pressure of veins and the tearing of vessels (3). In our case, CSF fistula formation confirmed with contrast lumbar CT and there may be an overdrainage from this fistula.

An another causal factor is exaggerated dehydration. It is presumed that aggressive intraoperative dehydration reduced the ICP, and consequently, sagging of the cerebellum might have reinforced the remote intra cerebral hematoma (9).

Cerebellar hemorrhage after a spinal procedure has been reported previously and should be considered as a potential source of unexplained neurological decline after spinal surgery. Postoperative imaging of the brain, however, would be distinctly uncommon in an asymptomatic patient after a spinal procedure. The occurrence of remote cerebellar hemorrhage is important to consider if the patient complains of severe headache, vomiting or unexplained neurological deterioration following spinal surgery (4,8).

The occurrence of cerebellar hemorrhage after spinal procedures with the patient in both the prone and sitting positions, however, suggests that position is not relevant to the pathogenesis of this complication after spinal procedures and casts some doubt on its role in the development of RCH after supratentorial procedures (4). Hur et al. suggested that intracerebellar hemorrhage after supratentorial operation have emphasized the intracranial hypotension and parenchymal shift due to overdrainage of CSF and the patient's position during craniotomy or trephination (10). Park, et al. suggested that the position of the patient during operation leads to displacement of the cerebellum and intracranial hypotension with subsequent injury of vessels (11). Yoshida, et al., proposed that an overdrainage of CSF during craniotomy can lead to an upward displacement of the cerebellum, which can cause stretching and possible tearing of the superior vermian vein (12). Brisman, et al., described that dehydration and over drainage of CSF during craniotomy result in shearing injury and displacement of vascular structures (13). After accomodating by our case, our findings has been supporting the theory of "sagging".

The incidence of remote cerebellar hemorrhage after spinal surgery might be higher than expected because postoperative brain CT or MRI are not routinely performed

after spinal surgery, and cranial lesions are unlikely to be considered (7). Although it is an extremely rare complication, remote cerebellar hemorrhage should be kept in mind as a possible complication of spinal surgery, especially in operations complicated by dural tears.

## CONCLUSION

RCH is an alarming but seldom reported complication of supratentorial craniotomies. With this unique case which present RCH after spinal operation support the hypothesis of cerebellar sagging due to CSF hypovolemia. But RCH is also a self-limiting phenomenon, and further surgical and diagnostic evaluation is not required as in our case. It is important to be aware of this complication as a potential causative factor of unexplained neurological deterioration or disturbance on emergence from anesthesia after spinal surgery. Early diagnosis and treatment of this complication are of great importance to patient outcome.

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