



Case Report

Hemorrhagic complications after removal of an external ventricular drain: A case report and literature review

Nikolaos Plakopitis^{1*}, Konstantinos Themistoklis^{2#}, Konstantinos Melanis³, Eleftherios Spartalis⁴, Panayiotis Patrikelis⁵, Themistoklis Papisilekas²

¹Department of Pharmacology, Translational Neurology Research Group, Medical School of Athens, ²Department of Neurosurgery, Korgialenio, Benakio, HRC General Hospital of Athens, ³Department of Neurology, "Evangelismos" General Hospital of Athens, ⁴Laboratory of Experimental Surgery and Surgical Research, University of Athens, ⁵Department of Neurosurgery, "Evangelismos" General Hospital of Athens, Athens, Greece.

E-mail: *Nikolaos Plakopitis - nikolaspl22@gmail.com; Konstantinos Themistoklis - themkostas@gmail.com; Konstantinos Melanis - melaniskos@gmail.com; Eleftherios Spartalis - eleftherios.spartalis@gmail.com; Panayiotis Patrikelis - ppatrik@cc.uoi.gr; Themistoklis Papisilekas - th.papisilekas@gmail.com

#These authors have contributed equally in the preparation of the manuscript.



***Corresponding author:**

Nikolaos Plakopitis,
Department of Pharmacology,
Translational Neurology
Research Group, Medical School
of Athens, Athens, Greece.

nikolaspl22@gmail.com

Received: 14 May 2023

Accepted: 08 August 2023

Published: 25 August 2023

DOI:

10.25259/SNI_415_2023

Quick Response Code:



ABSTRACT

Background: External ventricular drainage (EVD) is one of the most common neurosurgical procedures. Complications are rather rare and mostly include hemorrhage and infection. Hematomas may form during placement or even after the removal of an EVD. Regarding the latter, the literature is scarce, with only nine clinically significant cases reported.

Case Description: We present the case of a young woman who suffered an extensive hemorrhage after removal of an EVD, in the setting of a posterior fossa stroke. We discuss the management and possible consequences of such an event and we emphasize the need for alertness to avoid such complications.

Conclusion: Removal of an EVD is a safe procedure, with rare cases of hemorrhagic complications being reported. A case of a large hematoma that formed after the removal of an EVD is presented. Stricter follow-up protocols should be implemented to better estimate the risk of hemorrhage.

Keywords: External ventricular drainage, External ventricular drainage removal, Hemorrhage, Ventriculostomy

INTRODUCTION

Placement of an external ventricular drainage (EVD) is arguably one of the most common and important life-saving procedures in neurosurgery.^[2,4,5] Primary indications include cerebrospinal fluid diversion and management of intracranial pressure (ICP), while rarely an EVD can also be used for intraventricular administration of antibiotics, in cases of ventriculitis.^[2,4,5]

When Dandy introduced the technique of bedside ventriculostomy in his landmark paper, back in 1918, he confidently stated that the procedure was complication-free in experienced hands.^[1] However, this has proved not to be true. As with every other invasive method, ventricular drainage carries certain risks, namely, that of infection.^[2,4,5] A much rare complication is hemorrhage which can happen either during placement of an EVD or, even less commonly, during its removal.^[2-6]

The scope of this article is to describe the case of a young female stroke patient who suffered a major intracerebral hemorrhage after an EVD removal. We also present a brief review of the

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

©2023 Published by Scientific Scholar on behalf of Surgical Neurology International

relevant literature. To the best of our knowledge, there are only eight other cases in the literature of clinically significant or large hematomas associated with the removal of an EVD.^[3-6]

CASE REPORT

A 44-year-old woman with an unremarkable medical history presented at the emergency department of our hospital due to acute onset gait imbalance accompanied by vertigo. Symptoms had already been present for several hours before her admission. On neurological examination, she was found to be confused, with a wide-based ataxic gait as well as right-sided dysmetria and dysdiadochokinesia. Dysarthria and right-beating nystagmus were also noted (National Institutes of Health Stroke Scale-5). A brain magnetic resonance imaging scan with IV contrast revealed ischemia of the right cerebellar hemisphere. Further, workup, including an ultrasound of the carotid and vertebral arteries, a heart ultrasound, a brain, and cervical area computed tomography (CT) angiogram as well as a cerebral digital subtraction angiography, revealed no other underlying pathology. Her vital signs on presentation were recorded as respiratory rate 15, blood pressure (BP) 155/95 mmHg, pulse rate 88 bpm, oxygen saturation 99%, and T 37.0°C.

Deemed outside the time frame for thrombolysis and with no thrombectomy service available on site, the patient was started on aspirin and rosuvastatin (secondary stroke prevention) and she was transferred to the neurological ward where she remained for the next 48 h, essentially unchanged. Of note, her BP throughout this initial period remained within normal limits ruling out hypertension as the underlying cause of the bleeding. However, on day 3 of her admission, the patient gradually became unresponsive. An emergency brain CT scan revealed acute obstructive hydrocephalus with dislocation of the fourth ventricle due to edema around the ischemic lesion. No significant brainstem compression was noted. As a result, the patient was intubated and an EVD was put in place at the OR. Aspirin was discontinued due to the intervention and she was moved to the intensive care unit for further hospitalization. Three days later, she was extubated and on day 7, after successful weaning, the EVD was scheduled to be removed. Her vital signs and blood tests were all within normal range. Due to a busy schedule on that particular day, the EVD was left for the on-call resident to take out; after all elective procedures would be complete. Removal was performed as per standard protocol, on the bedside. On completion of the procedure, the patient immediately complained of a headache and within the following hour, she fell into a stupor. She was again intubated with a new brain CT scan showing obstructive hydrocephalus due to hemorrhage extending along the EVD track and down to the lateral and third ventricles [Figure 1].

In response to that, bilateral frontal EVDs were once again put in place alongside an ICP monitor. These remained for a total of 10 days and were removed only after serial CT scans had confirmed complete lysis of the clot. ICP values were normal throughout. The patient was successfully extubated 24 h later with no new neurological deficits being noted. The patient remained in the neurological ward for another 10 days and was finally discharged to a rehabilitation center with mild ataxia symptoms along with generalized weakness. All possible underlying stroke causes were ruled out.

DISCUSSION

Even though EVD removal is generally considered to be a technically simple and safe procedure, there have been reports in the literature of hemorrhage complications and even deaths following such a maneuver. An EVD-associated hemorrhage is characterized as clinically significant in all cases that a patient suffers a temporospatially related neurological deterioration. Obviously, this depends on the extent of the hemorrhage and also on its exact location. The latter is fairly constant in EVD cases and in close proximity to Kocher's point, the presence or absence though of intraventricular extension significantly alters prognosis.^[3,6] Regarding the size of a given hematoma, this largely depends on idiosyncratic factors and can be arbitrary with coagulopathies and antithrombotics being obvious risk factors.^[3,5,6]

Clinically, significant hemorrhages following an EVD removal, although rare, do often require intervention. In general, ventriculostomy revision with insertion of a new EVD at either the ipsilateral or contralateral side is the treatment of choice while clot evacuation is indicated when its intraparenchymal component is of a sufficient size.^[2,3,6] Withdrawal or reversal of antithrombotic medication with concurrent transfusion of platelets, if applicable, may also be considered.^[2]

To the best of our knowledge, there are only five other articles in the literature referring to post EVD removal hemorrhages [Table 1]. The first such report has been published by Ross and Dhillon back in 2003 describing two relevant cases – both under antithrombotics after an endovascular procedure and both clinically significant – in a total of 24 patients undergoing a ventriculostomy.^[6] Following this initial article, Gardner *et al.*, in 2009, reported 13 hemorrhages after the removal of an EVD in a series of 188 patients with no case though deemed actually of a clinical significance.^[2] Going on, Kung *et al.*, in 2011, reported one clinically significant hemorrhage (death) following EVD removal in a series of 131 patients with a total of 159 EVD placements (all patients were on antiplatelets after stent-assisted aneurysm coiling).^[3] Miller and Guillaume, in 2015, published a study including 63 pediatric patients with a total of 73 EVD insertions

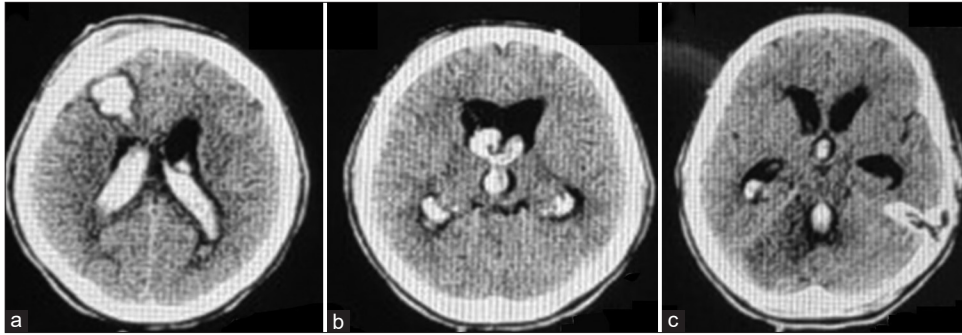


Figure 1: (a-c) Emergency brain computed tomography scan after external ventricular drainage (EVD) removal showing acute hemorrhage along the EVD path and within the lateral and third ventricles. Furthermore, signs of obstructive hydrocephalus.

Table 1: Hemorrhages after EVD removal and their severity, imaging findings and concomitant medication.

Author (s)	Ventriculostomy-related procedures	CT scans after EVD removal	Hemorrhages on CT after EVD removal	Clinically significant or large hemorrhage after EVD removal	Anticoagulation/Antiplatelet drugs
Ross and Dhillon	24	N/a	2	2	Yes
Gardner <i>et al.</i>	188	166	13	0	N/a
Kung <i>et al.</i>	N/a	N/a	N/a	1	Yes
Miller and Guillaume	73	32	7	N/a	Yes
Miller and Tummala	482	244	55	5	Yes
Plakopitis <i>et al.</i> (current report)	1	1	1	1	No

EVD: External ventricular drainage, CT: Computed tomography, N/a: Non available

and seven CT verified (all asymptomatic) postremoval hemorrhages (out of 32 CTs in total to investigate this).^[4] Finally, Miller and Tummala again, in 2017, reported 55 cases of hemorrhage after EVD removal in a total of 224 CT scans performed to investigate for this. Three of these cases were described as clinically significant (one associated death) and two were characterized as large.^[5]

Extrapolating data from the aforementioned studies, EVD removal carries an overall bleeding risk ranging from 7.8% to 22.5%, while the risk for clinically significant and/or large hemorrhages ranges from 0% to 2%. The mortality rate due to hemorrhages after EVD removal ranges between 0% and 0.2%. Notably, no uniform hemorrhage evaluation protocol has been applied with most patients only scanned on the indication of new symptoms (i.e., patients with small-scale hematomas may have been missed). It is thus safe to assume that the incidence of this kind of hemorrhages has been miscalculated and only routine post EVD removal imaging will help us extrapolate proper data.

Before closing, it should be underlined that an often overlooked consequence of EVD-related hemorrhages is their potential to act as an epileptogenic site.^[3,4,6] Given that a seizure may well present itself years after initial hospitalization, no study has had enough of a follow-up to address the issue.

A standardized assessment protocol should be established to adequately track such cases and evaluate associated risks.

CONCLUSION

As already mentioned, the removal of an EVD is considered to be both safe and simple. In rare cases however, there can be complications with hemorrhage being the most serious one. To the best of our knowledge, this is the ninth report of clinically significant such hemorrhage, with another eight cases reported in five articles. Since the above-described incident in our department, we have altered our protocol to carry out EVD removals in an operation room (OR) setting. Furthermore, although no one felt that what happened had anything to do with our trainee's actions, we have rearranged the training curriculum to put special emphasis on EVD management for our junior residents. To better estimate the risk of hemorrhage during an EVD removal and its impact on the final outcome, we believe that stricter follow-up protocols need to be implemented in clinical practice.

Declaration of patient consent

Patient's consent not required as patient's identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The author(s) confirms that there was no use of Artificial Intelligence (AI)-Assisted Technology for assisting in the writing or editing of the manuscript and no images were manipulated using the AI.

REFERENCES

1. Dandy WE. Ventriculography following the injection of air into the cerebral ventricles. *Ann Surg* 1918;68:5-11.

2. Gardner PA, Engh J, Atteberry D, Moossy JJ. Hemorrhage rates after external ventricular drain placement. *J Neurosurg* 2009;110:1021-5.
3. Kung DK, Policeni BA, Capuano AW, Rossen JD, Jabbour PM, Torner JC, *et al.* Risk of ventriculostomy-related hemorrhage in patients with acutely ruptured aneurysms treated using stent-assisted coiling. *J Neurosurg* 2011;114:1021-7.
4. Miller C, Guillaume D. Incidence of hemorrhage in the pediatric population with placement and removal of external ventricular drains. *J Neurosurg Pediatr* 2015;16:662-7.
5. Miller C, Tummala RP. Risk factors for hemorrhage associated with external ventricular drain placement and removal. *J Neurosurg* 2017;126:289-97.
6. Ross IB, Dhillon GS. Ventriculostomy-related cerebral hemorrhages after endovascular aneurysm treatment. *AJNR Am J Neuroradiol* 2003;24:1528-31.

How to cite this article: Plakopitis N, Themistoklis K, Melanis K, Spartalis E, Patrikelis P, Papisilekas T. Hemorrhagic complications after removal of an external ventricular drain: A case report and literature review. *Surg Neurol Int* 2023;14:298.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Journal or its management. The information contained in this article should not be considered to be medical advice; patients should consult their own physicians for advice as to their specific medical needs.