Cureus
Part of SPRINGER NATURE

Open Access Case Report

Refractory Cerebrospinal Fluid Leak After Chiari I Decompression Followed by Resolution After Prolonged Lumbar Drainage: A Case Report

Review began 04/15/2026
Review ended 11/03/2026
Published 11/11/2026

© **Copyright** 2026
Evans et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.119508

Nicole E Evans [1], Luis Londoño [1], Diego Méndez [1], Alejandra Gutierrez [1], Leonardo De J Barrios S [2]

1. Faculty of Medicine, Universidad De Panamá, Panama, PAN 2. Neurological Surgery, The Panama Clinic, Panama, PAN

Corresponding author: Nicole E Evans, ne.evansnicole@gmail.com

Abstract

Chiari malformation type I (CMI) is characterized by descent of the cerebellar tonsils below the foramen magnum and is frequently associated with altered cerebrospinal fluid (CSF) flow. Posterior fossa decompression (PFD) is the standard treatment, and CSF leakage is one of its most common complications. A 21-year-old woman presented with a two-year history of progressive holocranial headache, dizziness, gait instability, and paresthesias. Magnetic resonance imaging (MRI) revealed 15 mm of cerebellar tonsillar descent. She underwent PFD with duraplasty and C1 posterior arch resection. Postoperatively, she developed a refractory CSF leak despite wound resuturing and subsequent dural reinforcement using a fascia lata graft. A lumbar drain was subsequently placed and maintained for 21 days, resulting in complete resolution of the leak without further surgery or infectious or drain-related complications. Her neurological deficits and headache had resolved by the one-month follow-up, and she remained asymptomatic without recurrence at three and six months. No validated algorithm defines the optimal timing or duration of lumbar drainage, and reported drainage durations rarely exceed two weeks. This single, hypothesis-generating observation suggests that prolonged lumbar drainage guided by drain output may be considered a salvage strategy in highly selected, closely monitored patients, although its safety beyond this duration remains unestablished.

Categories: Therapeutics, Neurology, Neurosurgery
Keywords: cerebrospinal fluid leak, chiari malformation type 1, lumbar drainage, posterior fossa decompression, refractory cerebrospinal fluid leak

Introduction

Chiari malformations (CM) comprise a heterogeneous group of congenital anomalies of the craniocervical junction, characterized by abnormal displacement of hindbrain structures and altered cerebrospinal fluid (CSF) dynamics at the level of the foramen magnum [1]. Classically, they are divided into types I through IV based on the extent of anatomical involvement.

Chiari malformation type I (CMI) is the most common form in adolescents and adults and is defined by descent of the cerebellar tonsils ⩾5 mm below the foramen magnum, with secondary alterations in CSF flow. Although symptomatic cases account for approximately 0.1% of the population, the condition remains clinically significant. Patients may present with occipital headache, cerebellar symptoms, and myelopathy [2]. Posterior fossa decompression (PFD) is the treatment of choice in symptomatic patients and in those with associated syringomyelia, which may be extensive or even holocordal [1,3].

Although surgery generally leads to clinical and radiological improvement, PFD is not without complications. The most commonly recognized complications are CSF leakage, pseudomeningocele, and infection, particularly when duraplasty is performed [4]. CSF leakage is reported in up to 17% of posterior fossa operations and in approximately 2% of adult CMI duraplasties [5,6]. It results from incomplete dural closure, graft failure, or wound breakdown and is sustained by CSF pressure, which keeps the defect open [5,7]. Its consequences are clinically important: an open CSF pathway to the skin increases the risk of meningitis and wound infection, and it often leads to reoperation and prolonged hospitalization [8].

Most series report resolution with stepwise measures such as resuturing, dural reinforcement, or lumbar drainage, which reduces CSF pressure and allows the dural defect to seal [5,7]. Persistence of the leak after repeated surgical repair is uncommon and poorly described. No validated criteria define when to initiate drainage, when to reoperate, or how long drainage should be maintained [7]. The limited evidence regarding the timing of drainage and reoperation underscores the relevance of the present case.

Case Presentation

A 21-year-old woman with no known prior medical history developed a holocranial headache in 2023, rated 8/10 on a numeric pain scale and associated with dizziness and episodes of presyncope. The headache was exacerbated by coughing, emotional stress, and Valsalva maneuvers. She also reported gait instability, with a

tendency toward recurrent falls, and bilateral upper- and lower-extremity paresthesias.

Symptoms progressively worsened over the following two years, with headache intensity increasing to 10/10 and gait impairment becoming more pronounced. In 2025, she was evaluated in the outpatient neurosurgery clinic. Brain magnetic resonance imaging (MRI) revealed caudal displacement of the cerebellar tonsils approximately 15 mm below the foramen magnum, consistent with Chiari I malformation (CMI) (Figure *1*). MRI of the cervical, thoracic, and lumbar spine showed no syringomyelia or other structural abnormalities.

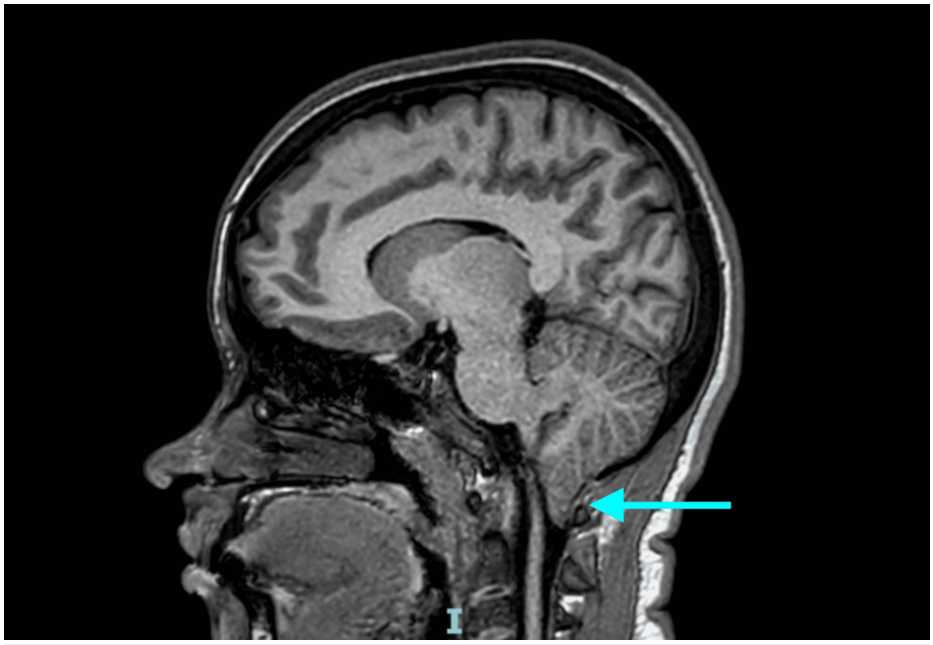


FIGURE 1: Sagittal T1-weighted MRI demonstrating CMI

Sagittal T1-weighted magnetic resonance image of the brain showing caudal displacement of the cerebellar tonsils approximately 15 mm below the level of the foramen magnum (arrow), consistent with CMI.

MRI, magnetic resonance imaging; CMI, Chiari malformation type I

On admission, neurological examination revealed bilateral upper extremity weakness graded 3/5, with decreased sensation in the C4-T1 dermatomes. Hyporeflexia was noted in the upper extremities, predominantly on the right, while hyperreflexia was present in the lower extremities. Gait was wide-based and unsteady, with irregular steps and an inability to maintain balance or perform tandem walking. Babinski and Hoffmann signs were absent, autonomic dysfunction was not identified, and the remainder of the neurological examination was unremarkable. Laboratory studies were within normal limits.

The procedure was performed at a secondary referral hospital by a neurosurgical team. Under general endotracheal anesthesia, the patient was placed in the prone position. A midline linear incision was made from the external occipital protuberance to the C2 spinous process, and the paraspinal muscles were detached subperiosteally. A posterior fossa craniectomy and resection of the posterior arch of C1 were performed.

The dura was opened in a Y-shaped fashion, with division of the occipital sinus, and arachnoid adhesions were released. Inspection revealed descent and flattening of the cerebellar tonsils. Following decompression, cerebellar pulsatility was restored. Dural tack-up sutures were placed, and an expansile duraplasty was performed using a 3 cm × 3 cm collagen graft, sealed with fibrin glue and reinforced with a hemostatic matrix over the defect. No CSF leakage was observed. After irrigation and hemostasis, the wound was closed in layers. Operative time was 180 minutes, blood loss was minimal, and there were no intraoperative complications.

On postoperative day (POD) 1, she experienced an isolated episode of nausea and vomiting without deterioration in her general clinical condition or hemodynamic instability. On POD 3, clear fluid was observed saturating the dressing, consistent with a CSF leak, prompting surgical exploration and wound revision. Intraoperatively, no pseudomeningocele was identified, and the duraplasty appeared intact; therefore, the wound was resutured. On POD 5, cranial computed tomography (CT) showed no evidence of hydrocephalus.

On POD 12, recurrent CSF leakage through the wound was identified, raising suspicion of a persistent fistula. The patient underwent reoperation with placement of an autologous fascia lata graft for dural reinforcement. Upon emergence from anesthesia, she experienced another isolated episode of nausea and vomiting, and CSF leakage persisted postoperatively. A lumbar drain was placed at the L3-L4 level on POD 14 and maintained for 21 days (until POD 35), resulting in complete resolution of the leak (Table *1*, Figure *2*). No predefined drainage protocol was used; the drain was managed by the treating team according to clinical judgment and removed once drainage had ceased and the wound remained dry. CSF cultures obtained on drainage days 5 and 17 were negative.

Day of drainage	Drainage rate (mL/24 hours)
1	500
3	450
5	375
7	325
10	250
13	175
15	120
17	75
21	0

TABLE 1: CSF output from the lumbar drain

CSF, cerebrospinal fluid

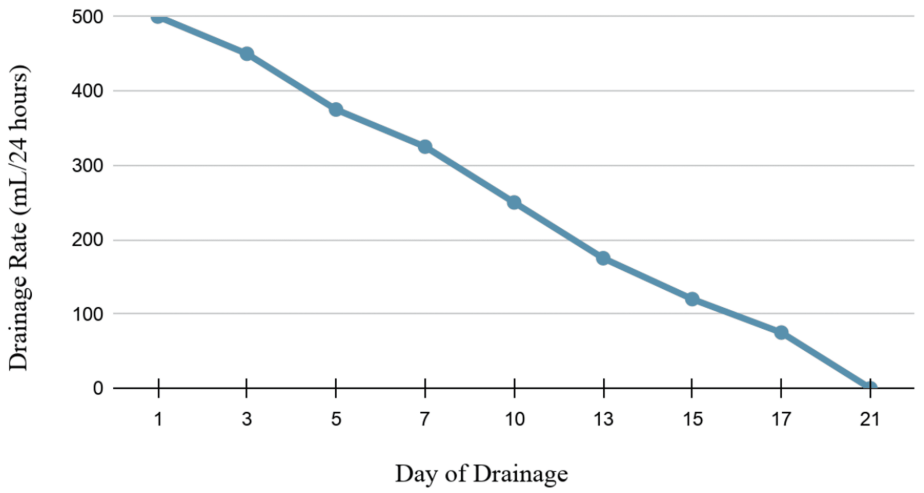


FIGURE 2: CSF output from the lumbar drain

The drain was placed on POD 14. Output decreased progressively from 500 mL/24 h on drainage day 1 to 0 mL/24 h on day 21 (POD 35), at which point the drain was removed.

CSF, cerebrospinal fluid; POD, postoperative day

The remainder of the hospital course was uneventful, with no hemodynamic instability or infectious complications. Postoperative imaging was not performed because the patient remained asymptomatic. After discharge, close outpatient follow-up was maintained through the Neurosurgery and Physical Therapy clinics. At the one-month follow-up, neurological examination showed 5/5 strength in all extremities, normal sensation, and a normal gait with intact tandem walking. The patient reported complete resolution of her headache and no other symptoms. The surgical wound had healed and showed no signs of infection.

At the three- and six-month follow-up visits, she remained asymptomatic, with no recurrence of CSF leakage. Figure 3 summarizes the main clinical events.

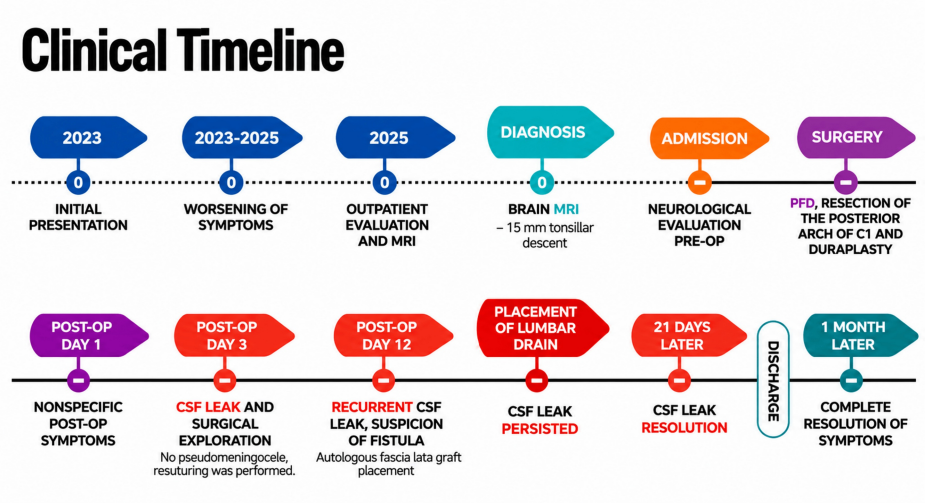


FIGURE 3: Timeline of clinical manifestations and events

MRI, magnetic resonance imaging; PFD, posterior fossa decompression; CSF, cerebrospinal fluid

The figure was created using Canva (Canva Pty Ltd., Sydney, New South Wales, Australia).

Discussion

In the absence of syringomyelia, her upper extremity weakness, C4-T1 sensory deficits, and lower extremity hyperreflexia were attributed to compression at the craniocervical junction. PFD with duraplasty restores CSF flow at the foramen magnum but carries an increased risk of CSF-related complications [4]. CSF leakage occurs in up to 17% of posterior fossa operations in general and in approximately 2% of adult CMI duraplasties [5,6]. Because the duraplasty appeared intact at the first revision, the leak was initially managed as a wound failure, and the wound was resutured. No validated algorithm defines the timing of drain placement or removal, although, in a mixed posterior fossa series, concomitant drainage resulted in greater leak resolution than resuturing alone [5,7]. The recurrence suggested a persistent dural-level leak at the collagen graft site, which was subsequently replaced with fascia lata, as autologous grafts are associated with lower CSF leak (1.8% vs. 5.3%) and revision rates [6]. Graft failure following PFD has also been reported [9]. Placement of a lumbar drain during that revision, as described in a Chiari case, might have shortened the treatment course [10].

Following two unsuccessful repairs, including one using an autologous graft, a pressure-related component to the persistent leak was suspected, making a third repair alone less likely to succeed. Permanent CSF diversion carries risks of overdrainage and hindbrain descent, as described following lumboperitoneal shunting in children [11]. Reversible lumbar drainage was therefore chosen. Its 21-day duration exceeded the mean of 7.2 days (range, 2-18 days) reported in a large spinal surgery series [12]. Drainage output declined progressively (Figure 2). With 325 mL/24 h still draining on day 7, conventional drain removal was considered potentially associated with recurrence, and delayed recurrence has been reported following spinal surgery [12,13]. A steady decline in output accompanied by a dry wound may suggest gradual sealing of the fistula rather than drain failure, which might manifest as plateauing output or persistent leakage. However, because drainage followed no predefined protocol, the observed decline may partly reflect drain management. To our knowledge, a 21-day lumbar drainage period following Chiari decompression has not previously been described.

In neurocritical care cohorts, 82% of lumbar drain infections occur within 12 days; therefore, per-day rates cannot be extrapolated to 21 days [14]. This risk must be considered alongside that associated with the open fistula, as CSF leakage is associated with markedly higher odds of infection after cranial surgery [9]. In our patient, CSF cultures obtained on drainage days 5 and 17 were negative. Other risks include low-pressure headache (1.7%-4.8%) and hemorrhage (1.7%), as reported with shorter-duration drains placed for other indications; neither complication occurred [15,16]. Lumbar drainage has caused tonsillar herniation in patients with CM who had not undergone decompression [17]. Following decompression, this mechanism is largely mitigated, and descent has been described mainly with permanent shunts or intracranial hypotension, rather than temporary drains [8,11]. She developed no symptoms suggestive of this complication. CT on POD 5 excluded hydrocephalus, and further imaging was reserved for clinical deterioration or drain failure, neither of which occurred.

This report has several limitations. It describes a single patient and therefore demonstrates the feasibility of prolonged drainage rather than establishing its safety; the safety of lumbar drainage beyond approximately two weeks has not been adequately studied. The effect of drainage cannot be distinguished from the natural maturation of the fascia lata repair. Furthermore, because no case series specifically addresses prolonged lumbar drainage after Chiari decompression, several risk estimates were derived from related populations and may not be directly applicable to this setting. These limitations underscore the importance of individualized management in complex postoperative scenarios. Further studies are needed to define the role of prolonged lumbar drainage and establish evidence-based guidelines for its use.

Conclusions

CSF leak is a common complication of PFD and may require stepwise management, ranging from conservative measures to surgical revision. In this patient, a leak that persisted despite two surgical repairs resolved after 21 days of lumbar drainage, without further surgery or infectious or drain-related complications. This single observation is hypothesis-generating and suggests that prolonged lumbar drainage, guided by drain output and close clinical and microbiological monitoring, may be considered as a salvage strategy in highly selected cases. Its safety and efficacy require further study.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Nicole E Evans, Diego Méndez, Luis Londoño, Leonardo De J Barrios S, Alejandra Gutierrez

Acquisition, analysis, or interpretation of data: Nicole E Evans, Diego Méndez, Luis Londoño

Drafting of the manuscript: Nicole E Evans, Diego Méndez, Luis Londoño, Leonardo De J Barrios S, Alejandra Gutierrez

Critical review of the manuscript for important intellectual content: Nicole E Evans, Diego Méndez, Luis Londoño, Leonardo De J Barrios S, Alejandra Gutierrez

Supervision: Leonardo De J Barrios S

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

The authors gratefully acknowledge Dr. Roberto Quijada and Dr. Irving Ortega, neurosurgeons at Hospital Nelson Collado, Chitré, for their assistance with case identification, clinical management, and diagnostic input.

References

1. Rosenblum JS, Pomeraniec IJ, Heiss JD: Chiari malformation (update on diagnosis and treatment) . Neurol Clin. 2022, 40:297-307. 10.1016/j.ncl.2021.11.007
2. Sadler B, Kuensting T, Strahle J, et al.: Prevalence and impact of underlying diagnosis and comorbidities on Chiari 1 malformation. Pediatr Neurol. 2020, 106:32-7. 10.1016/j.pediatrneurol.2019.12.005
3. Ciaramitaro P, Massimi L, Bertuccio A, et al.: Diagnosis and treatment of Chiari malformation and syringomyelia in adults: international consensus document. Neurol Sci. 2022, 43:1327-42. 10.1007/s10072-021-05347-3
4. Lin W, Duan G, Xie J, Shao J, Wang Z, Jiao B: Comparison of results between posterior fossa decompression with and without duraplasty for the surgical treatment of Chiari malformation type I: a systematic review and meta-analysis. World Neurosurg. 2018, 110:460-74.e5. 10.1016/j.wneu.2017.10.161
5. Altaf I, Vohra AH, Shams S: Management of cerebrospinal fluid leak following posterior cranial fossa surgery. Pak J Med Sci. 2016, 32:1439-43. 10.12669/pjms.326.9956
6. Perrini P, Lorenzini D, Vercelli A, Perrone A, Di Carlo DT: Post-operative complications after foramen

magnum decompression with duraplasty using different graft materials in adult patients with Chiari I malformation: a systematic review and meta-analysis. J Clin Med. 2023, 12:3382. 10.3390/jcm12103382

7. Falcão L, Gonçalves JP, do Lago MS, et al.: External lumbar drain for fistula leakage in posterior fossa and spinal surgery: a systematic review with meta-analysis. Neurosurg Rev. 2025, 48:715. 10.1007/s10143-025-03875-6
8. Kinaci A, Slot EM, Kollen M, et al.: Risk factors and management of incisional cerebrospinal fluid leakage after craniotomy: a retrospective international multicenter study. Neurosurgery. 2023, 92:1177-82. 10.1227/neu.0000000000002345
9. Kleyner RS, Passman JN, Chesler DA: Delayed dural graft breakdown and intracranial hypotension following posterior fossa decompression and duraplasty for Chiari malformation type I: illustrative case. J Neurosurg Case Lessons. 2025, 9:24715. 10.3171/CASE24715
10. Montgomery CT, Blue R, Spadola M, Ajmera S, Jabarkheel R, Schuster J: Navigated lumbar drain placement: a description of technique and case example. Surg Neurol Int. 2023, 14:116. 10.25259/SNI_100_2023
11. Chumas PD, Armstrong DC, Drake JM, et al.: Tonsillar herniation: the rule rather than the exception after lumboperitoneal shunting in the pediatric population. J Neurosurg. 1993, 78:568-73. 10.3171/jns.1993.78.4.0568
12. Kim JY, Oh BH, Kim IS, Hong JT, Sung JH, Lee HJ: The safety and effectiveness of lumbar drainage for cerebrospinal fluid leakage after spinal surgery. Neurochirurgie. 2023, 69:101501. 10.1016/j.neuchi.2023.101501
13. Feng X, Shi J, Huang X: Delayed cerebrospinal fluid leak (CSFL) occurring 21 days post-lumbar unilateral biportal endoscopic surgery: a case report. Medicine (Baltimore). 2026, 105:e46858. 10.1097/MD.0000000000046858
14. Scheithauer S, Bürgel U, Bickenbach J, et al.: External ventricular and lumbar drainage-associated meningoventriculitis: prospective analysis of time-dependent infection rates and risk factor analysis. Infection. 2010, 38:205-9. 10.1007/s15010-010-0006-3
15. Governale LS, Fein N, Logsdon J, Black PM: Techniques and complications of external lumbar drainage for normal pressure hydrocephalus. Neurosurgery. 2008, 63:379-84. 10.1227/01.NEU.0000327023.18220.88
16. Bakhshi SK, Suhail N, Mitha R, Moazzam M, Zahid N, Shamim MS: Lumbar drain for temporary cerebrospinal fluid diversion: factors related to the risks of complications at a university hospital. World Neurosurg. 2020, 143:e193-8. 10.1016/j.wneu.2020.07.120
17. Sugrue PA, Hsieh PC, Getch CC, Batjer HH: Acute symptomatic cerebellar tonsillar herniation following intraoperative lumbar drainage. J Neurosurg. 2009, 110:800-3. 10.3171/2008.5.17568