Dynamic Perfusion Reversibility in a Symptomatic Paediatric Developmental Venous Anomaly: A Case Report.

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Background

- Developmental Venous Anomalies (DVAs) are the most common cerebral vascular anomaly, often regarded as an extreme anatomical variant. However, a minority can become symptomatic with various proposed underlying mechanisms, including factors relating to high inflow or impaired outflow. The dynamic perfusion changes in symptomatic DVAs* associated with venous congestion remain poorly understood.

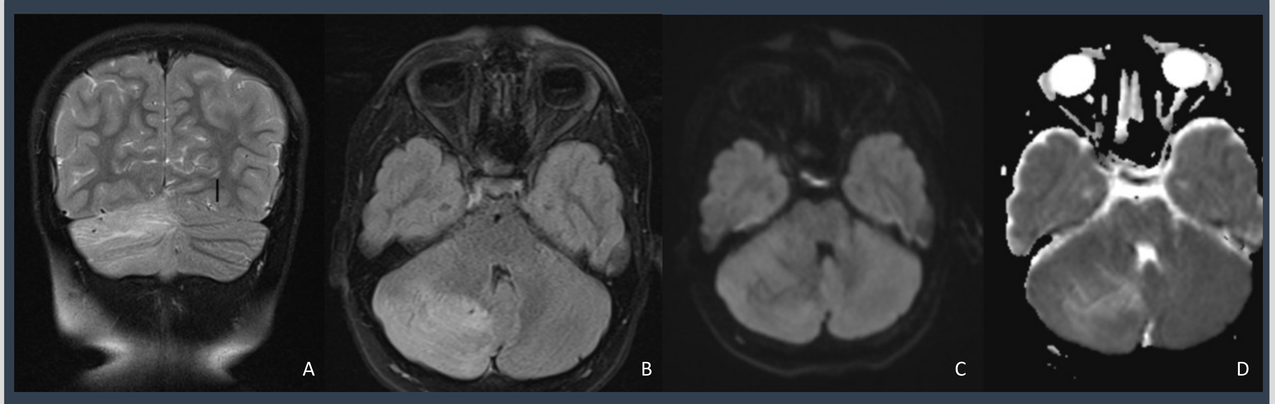
Abbreviations

* **DVA** Development Venous Anomaly.
** **ASL** Arterial Spin Labelling
*** **rCBF** Relative Cerebral Blood Flow
**** **MRA** Magnetic Resonance Angiogram
ˆMRV Magnetic Resonance Venogram
ˆˆ CTV Computer Tomography Venogram

Case report

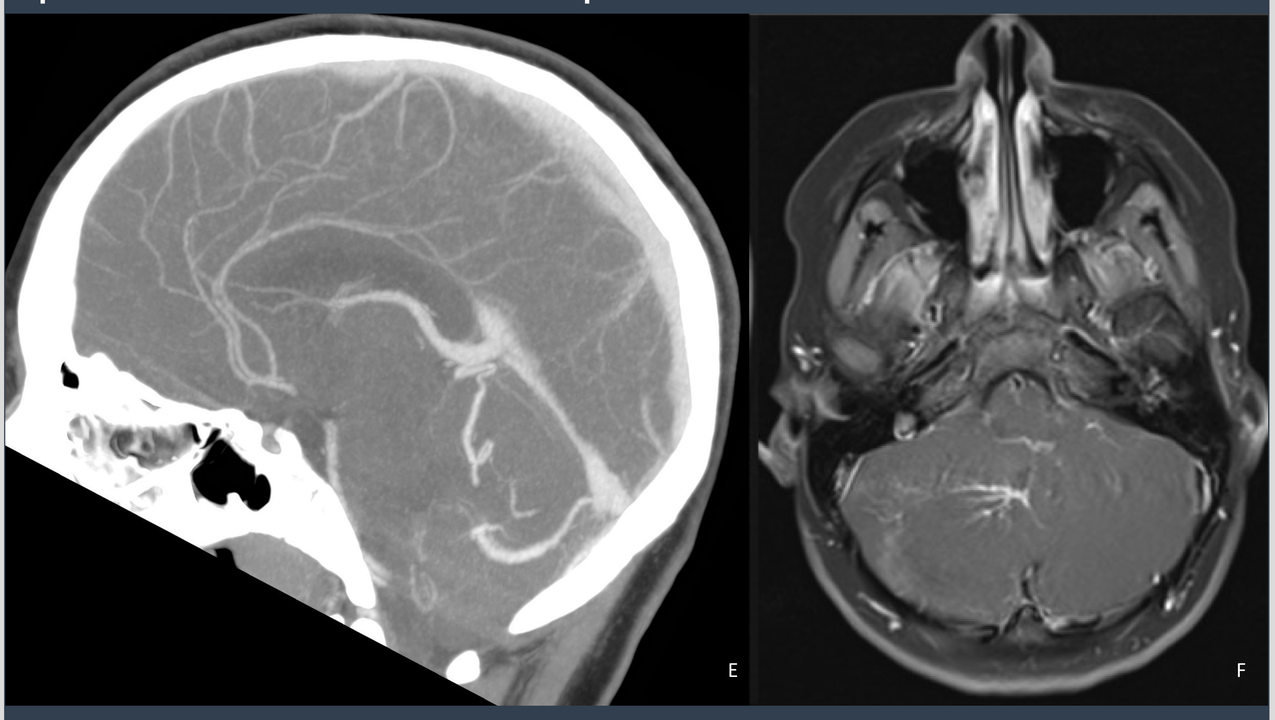
A 12-year-old female presented with a 7-day history of severe, positional headache (worsened when lying flat), and recurrent vomiting. Neurological exam was largely normal but revealed subtle cerebellar signs (left-sided hypermetria, pronator drift, truncal ataxia).
Initial MRI showed a T2/FLAIR hyperintense lesion in the right cerebellum, mass effect with early hydrocephalus, and a prominent medullary vein—later identified as a Developmental Venous Anomaly (DVA*). There was no evidence of diffusion restriction or enhancement suggestive of a tumor or infection.
Further vascular and perfusion imaging (MRA****, MRVˆ, CTVˆˆ, ASL**) ruled out thrombosis or arteriovenous malformation and showed reduced cerebral blood flow (rCBF) in the right cerebellum, likely due to venous congestion associated with the DVA*.
Steroid therapy was started on day 9 to treat presumed inflammation and edema. The patient improved clinically by day 10 and had near-complete radiological and symptomatic resolution by day 15. CSF analysis was negative for infection and autoimmune markers.
The patient was discharged on tapering steroids and made a full recovery by day 18.

Initial MRI on presentation



Left: Coronal (A) and Sagittal (B) FLAIR. Right: DWI (C) and ADC (D) map.

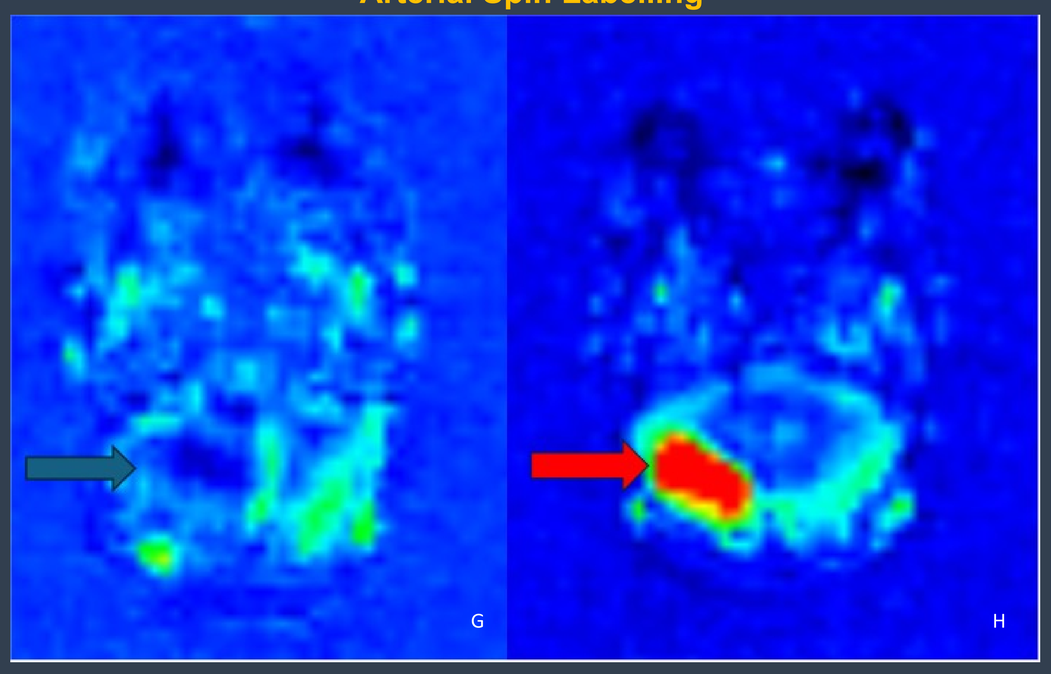
A,B: An MRI within 24 hours of admission revealed a T2/FLAIR hyperintense lesion in the right cerebellar hemisphere, causing mass effect, early hydrocephalus (not shown), and mild tonsillar herniation (not shown).
C,D: No diffusion restriction was seen on DWI. CSF paracentesis was not performed due to raised intracranial pressure.



Left: Sagittal CT Venogram (E). Right: Axial T1 + Contrast (F).

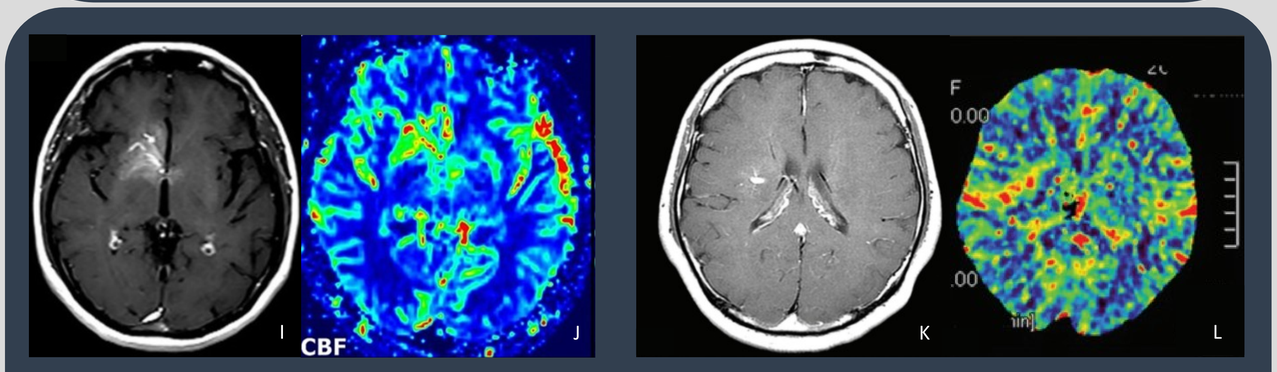
F,E: A prominent medullary vein within the right cerebellar hemisphere was identified as a Developmental Venous Anomaly (DVA*). The superficial and deep venous systems were patent with no venous sinus thrombosis. CT venogram did not demonstrate thrombosis or severe stenosis of the main collecting vein.

Arterial Spin Labelling



Left: Day 9 ASL (G) Right: Day 15 ASL** (H)**

G: Day 9 ASL demonstrating low signal intensity in rCBF*** in the region of the symptomatic DVA***
H: Day 15 ASL performed 5 days after patient began to show signs of clinical improvement. This demonstrated reversal of the flow pattern with increased signal intensity in rCBF*** in the region of the DVA*.**



Left: Axial T1+C (I) and Perfusion MR imaging (J) taken from N. Sahin et al. (2015)[3]
Right: Axial T1+C (K) and CT Perfusion (CBF*) (L) taken from R. Aoki et al. (2016)[2]**

MR (J) and CT (L) perfusion imaging taken from existing literature to illustrate previously described increased CBF* in DVAs* associated with venous congestion. To our knowledge, the transient reduction and complete reversal in blood flow demonstrated in our case (G,H) has not been previously described in literature.**

Discussion

- **Venous congestion in DVAs* is usually characterised by increased cerebral blood flow and volume, with prolonged mean transit time[2]. In contrast, symptomatic DVAs* can exhibit transient reduction in blood flow, resembling the perfusion pattern seen in acute venous sinus thrombosis. These findings suggest a more dynamic and variable perfusion pattern than previously recognised and highlight the value of serial perfusion imaging in monitoring disease evolution.**

Conclusion

- **We report a case of a symptomatic posterior fossa DVA* in a 12-year-old female, presenting with venous congestion, oedema and early hydrocephalus. Conservative management led to rapid clinical improvement, accompanied by serial ASL** perfusion imaging that demonstrated a dynamic and complete reversal of the flow pattern.**
- **This case highlights the dynamic perfusion abnormalities in symptomatic DVAs*, a phenomenon that has been underreported to date.**

References

1. Camacho DL, Smith JK, Grimme JD, Keyserling HF, Castillo M. Atypical MR imaging perfusion in developmental venous anomalies. AJNR Am J Neuroradiol. 2004 Oct;25(9):1549-52. PMID: 15502136; PMCID: PMC7976421.
2. Aoki R, Srivatanakul K. Developmental Venous Anomaly: Benign or Not Benign. Neurol Med Chir (Tokyo). 2016 Sep 15;56(9):534-43. doi: 10.2176/nmc.ra.2016-0030. Epub 2016 Jun 1. PMID: 27250700; PMCID: PMC5027236.
3. Sahin N, Solak A, Genc B, Bilgic N. Atypical developmental venous anomaly associated with contrast enhancement and hyperperfusion in the surrounding basal ganglia. Quant Imaging Med Surg. 2015 Jun;5(3):472-5. doi: 10.3978/j.issn.2223-4292.2014.09.02. PMID: 26029651; PMCID: PMC4426117.
4. Linscott LL, Leach JL, Zhang B, Jones BV. Brain parenchymal signal abnormalities associated with developmental venous anomalies in children and young adults. AJNR Am J Neuroradiol. 2014 Aug;35(8):1600-7. doi: 10.3174/ajnr.A3960. Epub 2014 May 15. PMID: 24831595; PMCID: PMC7964448.