Ischemic Stroke as the Initial Presentation of Moyamoya Syndrome (MMS) in a Pediatric Patient with Sickle Cell Disease (SCD)

Silvia Perrone[1], Filippo De Mattei[2], Roberto Ferri[2], Federica Masuzzo[2], Maria Claudia Torrieri[2], Manuela Matta[2], Marta Morra[1], Eleonora Virgilio[3], Marinella Clerico[2,3].

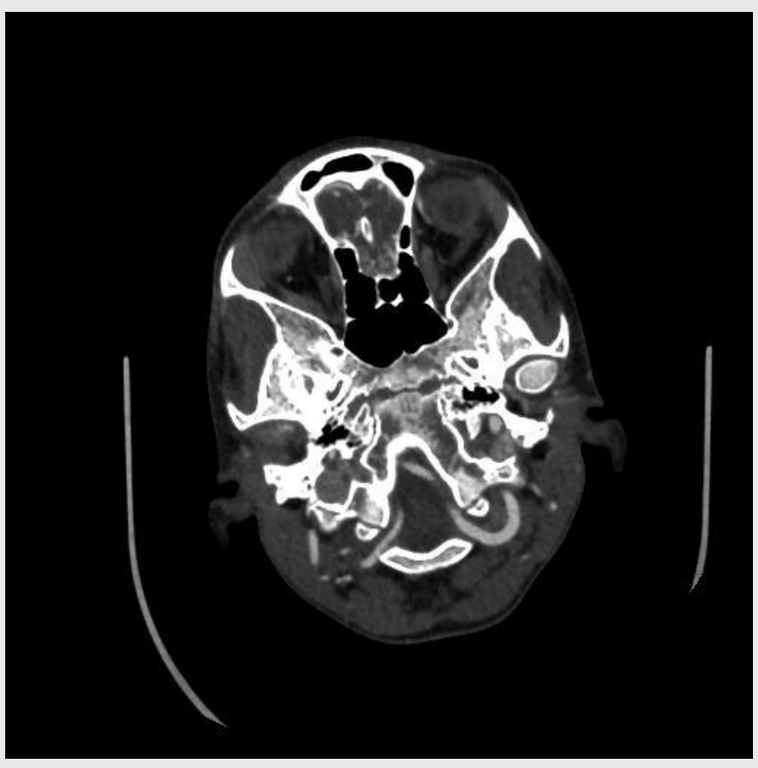
(1) Department of Neuroscience "Rita Levi Montalcini", University of Turin, Turin, Italy.
(2) SSD Neurology Department, San Luigi Gonzaga Hospital, Orbassano (TO).
(3) Clinical and Biological Sciences, University of Turin - Academic Neurology Unit, AOU San Luigi Gonzaga, Orbassano (TO).

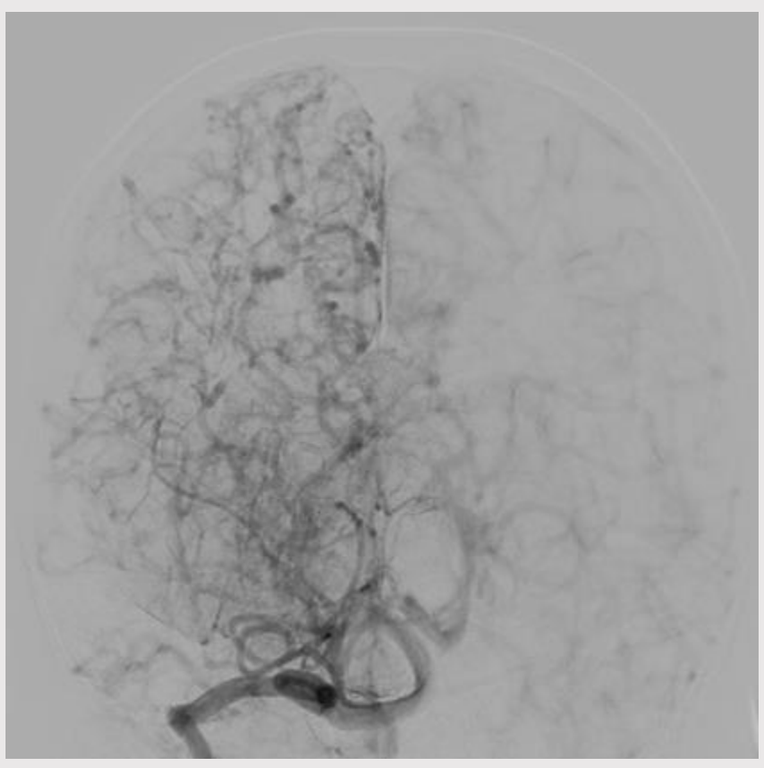
Objective and Methods

We report a pediatric case of MMS presenting as an ischemic stroke, exploring the challenges of managing patients with suspected stroke and SCD, especially in children.

Results

A 10-year-old female with known SCD and a history of ischemic stroke at age 3, presented to the emergency department with acute onset (approximately one hour prior to evaluation) of severe left-sided hemiparesis. Laboratory tests showed evidence of **hemolytic crisis** (elevated lactate dehydrogenase, indirect hyperbilirubinemia, and low haptoglobin levels).





✓ **CT and angio-CT:**
- Reduced cortico-subcortical differentiation in the right frontal lobe (ASPECTS 8).
- Narrowing of the right internal carotid artery, with near-complete occlusion extending from the supraclinoid segment into the M1 segment of the middle cerebral artery.

✓ **Cerebral angiography:**
- Chronic occlusive arteriopathy, consistent with MMS.
- Right internal carotid artery hypoplastic, tapering and terminating at the carotid siphon.
- Extensive dural–pial anastomotic network.
- Anastomoses between posterior and anterior circulations, predominantly via the posterior communicating artery.

✓ **MRI and angio-MRI:**
- Deep and cortical collateral networks.
- Acute ischemic lesions in the right fronto-insulo-temporal cortex and the left post-central gyrus.
- Several small acute ischemic lesions bilaterally across multiple cortical regions.

→
✓ **Erythrocytapheresis** → gradual improvement in motor function.
✓ Chronic treatment with erythrocytapheresis and hydroxyurea.
✓ Revascularization surgery by pedicled right superficial temporal artery.

Discussion

Stroke, silent cerebral infarcts, and cognitive impairment are well-documented complications of SCD. MMS, a progressive steno-occlusive arteriopathy affecting the distal internal carotid arteries and the circle of Willis, may occur as a secondary manifestation in SCD. The development of fragile collateral vessels - described as having a *"puff-of-smoke"* appearance - increases the risk of both ischemic and hemorrhagic events. Ischemic stroke should be considered as one of the initial presentation of MMS in patients with SCD.

Children

✓ Intravenous thrombolysis (IVT) is not recommended.
✓ Erythrocytapheresis → first-line treatment (achieve Hb 10 g/dL and HbS level 15-20%).
✓ Secondary stroke prevention for children with HbSS or HbSβ^0 thalassemia:
- Hemoglobin > 9 g/dL.
- HbS level at 30% of total hemoglobin.

Adults

✓ In older adults with SCD presenting with acute ischemic stroke, treatment with IVT is recommended within 4.5 hours of symptom onset.
✓ The utility of IVT and endovascular thrombectomy in MMD-associated acute ischemic stroke, appears feasible in selected cases; however, current evidence is largely limited to adult populations without SCD.

Conclusion

a) Need for standardized protocols and multidisciplinary management strategies.
b) Training neurologists to recognize and manage pediatric stroke is essential. Early diagnosis enables prompt initiation of therapy and allows appropriate planning for potential neurosurgical intervention.
c) This patient population should be included in the development of stroke guidelines and care pathways.

1. Koh, M. Y. *et al.* Intravenous thrombolysis and endovascular thrombectomy for acute ischaemic stroke in patients with Moyamoya disease - a systematic review and meta-summary of case reports. *J Thromb Thrombolysis* 54, 339–349 (2022).
2. Chen, H. *et al.* Efficacy and Safety of IV Thrombolysis for Acute Ischemic Stroke Patients with Moyamoya Disease. *Neurology* 104, (2025).
3. DeBaun, M. R. *et al.* American Society of Hematology 2020 guidelines for sickle cell disease: Prevention, diagnosis, and treatment of cerebrovascular disease in children and adults. *Blood Adv* 4, 1554–1588 (2020).