

# Teenage stroke: a brief insight with a description of two cases

**Ludovica Ferràù**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

**Fabrizio Giammello** (✉ [fabrizio.giammello@gmail.com](mailto:fabrizio.giammello@gmail.com))

Università degli Studi di Messina Dipartimento di Scienze biomediche odontoiatriche e delle immagini morfologiche e funzionali <https://orcid.org/0000-0002-2828-1305>

**Maria Carolina Fazio**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

**Francesco Grillo**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

**Sergio Lucio Vinci**

Università degli Studi di Messina Dipartimento di Scienze biomediche odontoiatriche e delle immagini morfologiche e funzionali

**Antonio Toscano**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

**Rosa Fortunata Musolino**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

**Cristina Dell'Aera**

Università degli Studi di Messina Dipartimento di Medicina Clinica e Sperimentale

---

## Research Article

**Keywords:** teenage stroke, cerebrovascular disease, stroke in young patients, reperfusion treatments

**Posted Date:** June 15th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-179695/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

**Version of Record:** A version of this preprint was published at SN Comprehensive Clinical Medicine on August 13th, 2021. See the published version at <https://doi.org/10.1007/s42399-021-01039-3>.

# Abstract

## Introduction:

Acute ischemic stroke (AIS) in teenagers occurs infrequently and is a real emergency with serious consequences for patients and their families. Both thrombectomy and thrombolysis are well tolerated but are still debated. Nowadays there are not sufficient data concerning the outcome of these treatments and only few studies and case reports proved their efficacy and safety.

## Case presentation:

Herein we present two reports of AIS in adolescents, for which different therapeutic approaches were performed, achieving a successful outcome in both cases without short or long-term complications.

## Conclusions:

The early recognition of teenage stroke is not always easy, due to the variability of causes and symptoms, but a good outcome can be achieved with reperfusion treatments performed as quickly as possible.

# Introduction

Acute ischemic stroke (AIS) in children and adolescents is very rare but represents one of the most important cause of disability and death at a young age <sup>1</sup>. The annual incidence for AIS in adolescence is ranging from 0.54 to 2.4 per 100,000 with a significant male predominance <sup>2,3</sup>. Teenage stroke (TS) has a significant impact on quality of life, work capacity and family costs representing a serious social disease, because of its association with high follow-up costs and long-term rehabilitative treatment <sup>2</sup>. The etiology of TS presents several differences from adults, varying with age, race and sex. Black and Asian adolescents have an increased risk of AIS because of a stronger predisposition for sickle cell anemia and iron deficiency, respectively <sup>4</sup>. In younger patients, the clinical picture is different from adult stroke, due to the total absence of the conventional risk factors, such as hypertension or diabetes. We described two cases of TS in patients aged 16 and 17, respectively, admitted to comprehensive stroke center (CSC) of Messina, Italy, between 2018 and 2020. A correct and prompt diagnosis allowed achieving good outcomes in terms of prognosis and residual neurological deficits.

# Case 1

A 17-year old girl was admitted to CSC for sudden loss of consciousness followed by global aphasia and severe right-sided hemiplegia (National Institute of Health Stroke Scale, NIHSS: 13). She had a history of migraine with aura, polycystic ovary syndrome (for which she was assuming estrogen-progestogen therapy from one year), and seizure-like episodes, occurred about three times before stroke event and characterized by severe pulsating headache, sweating, trembling and short-lasting loss of consciousness.

Cerebral computed tomography (CT) was normal. Brain magnetic resonance imaging (MRI) showed hyperintensities in left frontal lobe, with “spaghetti sign” on fluid attenuated inversion recovery (FLAIR) sequences. On MR angiography (MRA), M2 segment of left middle cerebral artery (MCA) and A2 and A3 segments of anterior cerebral artery (ACA) could not be visualized. MRI perfusion-diffusion mismatch predicted favorable outcomes to reperfusion (Fig. 1). After parental consent was obtained (underage patient), she underwent bridging therapy, combining intravenous thrombolysis with tissue-type plasminogen activator (IVT) at standard dose (0.9 mg/kg) and mechanical thrombectomy (MT) with optimal results. Ultrasonography (US) of the carotid and vertebral arteries was normal. Transcranial color doppler ultrasound (TCCD) detected the transit of microbubbles through a patent foramen ovale (PFO). The transesophageal echocardiography (TEE) confirmed the presence of a large-sized PFO (tunnel length > 10 mm). The patient reported no neurological sequelae, with NIHSS 0 at discharge. Two weeks after discharge, the patient has reported three recurrent seizures characterized by short periods of absence, treated with lacosamide (100 mg daily).

## Case 2

A 16-year-old boy was admitted to CSC for acute onset of dysarthria and right hemiparesis occurred during a swimming competition (NIHSS 11). Brain CT and MRI did not show abnormalities. Parental consensus was obtained and the patient was treated with IVT outside the therapeutic indications. About three hours after the end of IVT, neurological examination showed severe aphasia and right hemiplegia (NIHSS 15), but new CT brain was unchanged. Subsequently the patient showed progressive clinical improvement. The next day, MRI revealed nucleo-capsular hyperintensity on diffusion-weighted imaging (DWI) and FLAIR sequences, and MRA showed a suspected partially occlusive thrombus on the left MCA (Fig. 2). Nevertheless, repeated CTA and MRA checks did not showed the thrombus previously described, with patency of circle of Willis. All diagnostic tests performed during hospitalization such as carotid US, TCCD, transthoracic echocardiography (TTE), TEE and bilateral leg US were normal. Screening for rare causes of stroke, coagulopathies or thrombophilic and autoimmune diseases were unremarkable. We started therapy with acetylsalicylic acid 100 mg/day and intensive rehabilitation. After ten days, the patient was discharged as cryptogenic stroke with moderate recovery of speech and motility (NIHSS 4). At twenty-four months follow-up, he reported slight weakness to the right leg (NIHSS 1).

## Discussion

Infections, cardiac diseases, traumatic dissections, vasculopathies and hereditary coagulopathies are the most relevant risk factors in TS, although it often remains cryptogenic. Due to the rarity of the disease and the variability of clinical manifestations, diagnosis is often delayed. Younger patients frequently present seizures as first manifestations of AIS. Alteration of consciousness may also be seen<sup>1</sup>. The gold standard for diagnosis is DWI-MRI, characterized by low radiation risk and able to detect AIS within a short time. The optimal treatment approach in these patients remains unclear. Nowadays, the number of cases in which thrombolysis and endovascular therapy are performed has increased, even in very young

patients, supporting the efficacy and safety of reperfusion treatments<sup>3</sup>. The atypical episodes preceding AIS in case n.1, could be interpreted as seizures. Moreover she developed a post-stroke epilepsy. Both migraine and PFO has been involved occasionally in AIS, and their correlation especially with the PFO is probabilistic<sup>3</sup>. Migraine with aura is associated with an approximately two-fold increased risk of AIS in adults, while migraine aura state should be studied as a possible risk factor for stroke in younger patients<sup>5</sup>. Furthermore the use of estrogenic oral contraceptives is known to be associated with an increased risk of stroke in adult women affected by migraine with aura<sup>5</sup>, but there are not sufficient data to demonstrate similar association in adolescents. To determine stroke etiology is even more difficult in case n. 2, because no cause of AIS was identified during the diagnostic evaluations. Even after the findings of the suspected subocclusive thrombus in left MCA, showed one day after the AIS at MRA, MT was not performed due to the progressive regression of symptoms. Serial follow-up radiological controls have shown the possible artifact of the findings.

## Conclusion

The diagnosis of TS is challenging and options for the acute treatment are limited. It is well known that stroke in this very young patients is a real emergency and must be treated as quickly as possible. We presented two different cases of TS undergone different therapeutic approaches, aiming to contribute to data literature about the efficacy of reperfusion treatments with IVT and MT.

Both treatments are not recommend as a standard therapeutic option, due to the bleeding risk, but their use is increasing due to their efficacy and safety.

## Abbreviations

AIS: acute ischemic stroke; TS: teenage stroke; CT: computed tomography; MRI: magnetic resonance imaging; FLAIR: fluid attenuated inversion recovery; DWI: diffusion weighted imaging; MRA: MR angiography; MCA: middle cerebral artery; ACA: anterior cerebral artery; IVT: intravenous thrombolysis; MT: mechanical treatment; US: ultrasonography; TCCD: transcranial color doppler; PFO: patent foramen oval; TEE: transesophageal echocardiography; TTE: transthoracic echocardiography; NIHSS: National Institute of Health Stroke Scale.

## Declarations

**Participant consent statement:** The patients' parents provided oral consent to participate and publish the clinical data and images of the minors.

**Authors' contributions:** LF and CDA conceptualized the study. SLV and FGi performed imaging analysis. MCF, F.Gr, AT and RFM reviewed and critiqued the manuscript. LF, CDA and FGi wrote the original draft.

**Acknowledgement:** we thank the patients and their families for their kind cooperation.

**Funding:** this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Conflicts of interest:** the authors declare that there is no conflict of interest.

**Ethics approval:** The paper does not report on primary research. All data analysed were collected as part of routine diagnosis and treatment.

## References

1. Steinlin M. A clinical approach to arterial ischemic childhood stroke: Increasing knowledge over the last decade. *Neuropediatrics*. 2012;43:1–9.
2. Rambaud T, et al. Acute ischemic stroke in adolescents. *Neurology*. 2020;94:e158–69.
3. Gerstl L, et al. Childhood Arterial Ischaemic Stroke: Clinical Presentation, Risk Factors and Management. *Hamostaseologie*. 2020;40:165–73.
4. Mallick AA, et al. Childhood arterial ischaemic stroke incidence, presenting features, and risk factors: A prospective population-based study. *Lancet Neurol*. 2014;13:35–43.
5. Schürks M, et al. Migraine and cardiovascular disease: Systematic review and meta-analysis. *BMJ*. 2009;339:1015.

## Figures

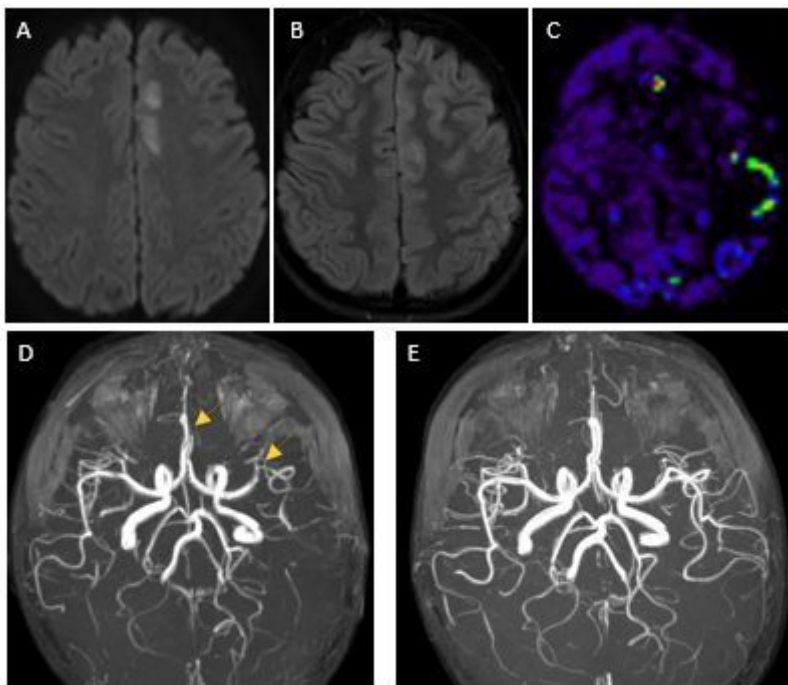
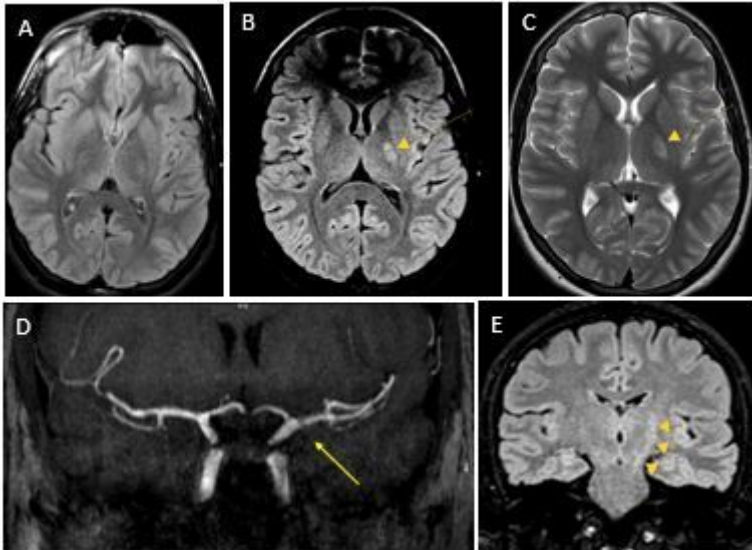


Figure 1

Magnetic resonance imaging (MRI). Fluid attenuated inversion recovery (FLAIR) showing hyperintensity in left frontal lobe (A); FLAIR revealing «spaghetti sign» on fronto-temporal lobes and interhemispheric fissure (B); the same leptomeningeal collaterals were lightened on pseudocontinuous arterial spin labeling (pc-ASL) (C); on MR angiography (MRA), time of flight (TOF) sequences revealed M2 segment of left middle cerebral artery (MCA) and A2-A3 segments of anterior cerebral artery (ACA) could not be visualized (D); MRA control revealed the patency of the very same segments of left MCA and ACA with flow retrieval (E).



**Figure 2**

First MRI not showing abnormalities on FLAIR sequences (A). MRI performed in the following day showing hyperintensity located in the left internal capsule and hippocampus on FLAIR (B) and T2 (C) sequences; MRA showing suspected partially occlusive thrombus in M1 segment of the left MCA (D), lightened with yellow arrow on Maximum Intensity Projection (MIP). Follow up MRI showing left pyramidal fascicle degeneration (yellow arrowheads) on coronal FLAIR sequences (E).

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [CAREchecklist.docx](#)