Case Report

Patent Foramen Ovale and Stroke in Adolescents - to Close or Not to Close?

Sónia Silva1, Cláudia Teles Silva1, Jacinta Fonseca1, Cláudia Melo2, Mafalda Sampaio2 and Raquel Sousa2

1Department of Pediatrics, Centro Hospitalar Universitário de São João, Porto, Portugal
2Department of Neuropediatrics, Centro Hospitalar Universitário de São João, Porto, Portugal

Abstract

Stroke is a rare condition in childhood and about half of the cases are due to an arterial ischemic event. Although the long list of known causes, many cases remain undetermined, so-called cryptogenic strokes. However, increasing evidence indicates that some of these cryptogenic cases can be a result of a paradoxical embolism via a Patent Foramen Ovale (PFO) with a right-to-left intracardiac shunt, but the exact contribution of PFO to stroke or stroke recurrence in childhood remains unclear. Considering this, as a second line of anatomic features.

We present two cases of a 16-year-old boy and a 17-year-old girl whom was found a PFO with a shunt, with the remaining exhaustive etiologic investigation all negative. Both of them underwent percutaneous closure of the PFO.

Keywords: Patent foramen ovale; Pediatric arterial ischemic stroke; Right-to-left shunt; Stroke

Discussion

Stroke is a rare condition in childhood [1]. Acute Ischemic Strokes (AIS) accounts for about half of all strokes in children [1-2]. Although hospitalizations for AIS in children have being in the past decade, with the improvement of medical knowledge, it is likely to be underdiagnosed or misdiagnosed, because of the low level of suspicion and frequent presentation of subtle symptoms that mimic other diseases [1,2]. The most well described risk factors in pediatrics for AIS are congenital heart disease, sickle cell disease, fection and...
hypocoagulable states [1]. Cerebral or cervicalarteriopathy can be identified in 50% to 80% of cases, corresponding to an independent risk factor [3-5]. Multiple risk factors are present in as many as 25% of children with stroke, which means further investigations are warranted even when one risk factor has been identified [2].

In spite of the long list of known causes and risk factors, the term “cryptogenic stroke” is used to define stroke in 20-30% of children where the etiology remains undefined despite extensive investigations [3,6]. A possible explanation for some AIS in children considered cryptogenic might be a paradoxical embolism in the presence of a right-to-left shunt in the heart such as PFO, with the microemboli going through right atrium into the systemic cerebral circulation [6,7]. Different studies found that the prevalence of PFO among cryptogenetic stroke patients is higher than in the general population (40-50% versus 20-25%) [4,5,7]. However, the exact rule of PFO to stroke or stroke recurrence in childhood remains unclear and this should be considered as a diagnosis of exclusion [3,7]. Venous thromboembolism, genetic coagulation disorders or atrial septal aneurysm seems to confer an additional risk to stroke in presence of a PFO [1,3,4,6]. An association between migraine and PFO has been suggested too [3].

There are several ways to investigate a suspected PFO, including TTE, TEE and TCD. TTE with colour doppler remains the initial mandatory investigation for the cardiac assessment of pediatric patients with stroke. TEE with color doppler is semi-invasive procedure, requiring sedation and esophagal intubation, but provides providing high-resolution pictures of the posteriorly left atrium and interatrial septum and is considered the gold standard to investigate the embolic source in stroke. TCD with bubble test detects particulate embolic material or gaseous microbubbles in the cerebral circulation in real time, but does not portray cardiac anatomy [3].

In the absence of age-appropriate safety data or dosing guidelines, children who present with AIS are sometimes treated outside of the recommended guidelines with rtPA or mechanical embolectomy, often extrapolated from data in adult stroke trials [1]. Anticoagulation and/or antiplatelet therapy can be used as prophylaxis. The risk and benefit likely by age and underlying stroke etiology, but again, in children there is a lack of definitive data [1,4,6,7]. In the absence of a deep vein thrombosis or known hypercoagulable state antiplatelet therapy is typically recommended. Modifiable risk factors should be aggressively addressed [4]. The percutaneous closure of PFO with intracardiac shunting to prevent recurrent stroke in children is controversial and should be individualized, based on significant shunting and risk factors. It is considered as a simple procedure with low risk. Patients with large shunts and those with a hypermobile interatrial septum receive particular benefit from PFO closure [6-8].

With the presentation of those two cases we pretend to highlight the importance of a high level of suspicion of stroke in children with neurological symptoms. The earlier diagnosis in the second case of stroke (with more suspicious symptoms on presentation) and PFO allowed respectively the treatment with pharmacologic thrombolysis and mechanical embolectomy and the closure of PFO during the first days of admission. An exhaustive study to exclude all the possible causes of AIS should be done, and paradoxical embolism viaPFO with-thright-to-left shunt should be considered, as well as the execution of TEE. Research about the treatment and prophylaxis of recurrence of AIS in the pediatric population is lacking and should be a priority. Closure of PFO should be considered as a preventive measure depending on individual risk factors and anatomic features.

**Conflict of Interest**

No conflict of interest is declared by all authors.

**Patient Consent**

Parental/guardian consent obtained.

**References**

1. Numis AL, Fox CK (2014) Arterial ischemic stroke in children: Risk factors and etiologies. Curr Neurol Neurosci Rep 14: 422.
2. Tsze DS, Valente JH (2011) Pediatric stroke: a review. Emerg Med Int 2011: 734506.
3. Khan R, Chan AK, Mondal TK, Paes BA (2016) Patent foramen ovale and stroke in childhood: A systematic review of the literature. Eur J Paediatr Neurol 20: 500-511.
4. Mackey J (2014) Evaluation and management of stroke in young adults. Continuum (Minneap Minn) 20: 352-369.
5. Bernard TJ, Goldenberg NA (2010) Pediatric arterial ischemic stroke. Hematol Oncol Clin North Am 24: 167-180.
6. Agnetti A, Carano N, Sani E, Tchana B, Allegri V, et al. (2006) Cryptogenic stroke in children: Possible role of patent foramen ovale. Neuropediatrics 37: 53-56.
7. Melkumova E, Thaler DE (2017) Cryptogenic stroke and patent foramen ovale risk assessment. Interv Cardiol Clin 6: 487-493.
8. Stortecky S, da Costa BR, Mattle HP, Carroll J, Horung M, et al. (2015) Percutaneous closure of patent foramen ovale in patients with cryptographic embolism: A network meta-analysis. Eur Heart J 36: 120-128.
