International Journal of Innovative Technologies in Social Science

e-ISSN: 2544-9435

Operating Publisher
SciFormat Publishing Inc.
ISNI: 0000 0005 1449 8214

2734 17 Avenue SW,
Calgary, Alberta, T3E0A7,
Canada
+15878858911
editorial-office@sciformat.ca

ARTICLE TITLE	ISCHEMIC STROKE OF THE BRAINSTEM WITH INVOLVEMENT OF THE OCULOMOTOR NERVE NUCLEUS AS A MANIFESTATION OF A PERSISTENT FORAMEN OVALE A CASE REPORT OF A 40-YEAR-OLD PATIENT
DOI	https://doi.org/10.31435/ijitss.2(50).2026.5731
RECEIVED	10 March 2026
ACCEPTED	16 June 2026
PUBLISHED	25 June 2026
LICENSE	The article is licensed under a **Creative Commons Attribution 4.0 International License.**

ISCHEMIC STROKE OF THE BRAINSTEM WITH INVOLVEMENT OF THE OCULOMOTOR NERVE NUCLEUS AS A MANIFESTATION OF A PERSISTENT FORAMEN OVALE A CASE REPORT OF A 40-YEAR-OLD PATIENT

Krystyna Klahs *(Corresponding Author, Email: krysia.99.klahs@gmail.com)*
Independent Public Specialist Health Care Facility in Lębork, Poland
ORCID ID: 0009-0001-7747-6854

Kaja Nieradka
Clinical Provincial Hospital of Saint Jadwiga the Queen in Rzeszów, Poland
ORCID ID: 0009-0009-4373-3726

Maciej Muraszko-Kuźma
District Hospital in Limanowa of the Name of Divine Mercy, Poland
ORCID ID: 0009-0003-4812-1493

Patryk Twardy
Clinical Provincial Hospital of Saint Jadwiga the Queen in Rzeszów, Poland
ORCID ID: 0009-0009-5510-3545

Weronika Wagner
Clinical Provincial Hospital of Saint Jadwiga the Queen in Rzeszów, Poland
ORCID ID: 0009-0001-0269-0418

Jakub Białożyt
University Clinical Hospital No. 2 PUM in Szczecin, Poland
ORCID ID: 0009-0000-2721-6694

Anna Dębniak
University Clinical Hospital No. 2 PUM in Szczecin, Poland
ORCID ID: 0009-0009-8511-3912

Maciej Gutarowicz
Independent Public Provincial Hospital in Szczecin, Poland
ORCID ID: 0009-0003-5139-3756

Patryk Modelewski
University Clinical Hospital No. 2 PUM in Szczecin, Poland
ORCID ID: 0009-0009-0682-4901

Michał Armatys
UNO-MED Medical Center, Tarnów, Poland
ORCID ID: 0009-0003-9647-8091

ABSTRACT

Aim: In our work, we want to emphasize the clinical importance of patent foramen ovale. It's a potential cause of stroke in young patients without classic vascular risk factors. We want to feature the significance of transesophageal echocardiography in detecting foramen ovale and preventing stroke.
Methods: We present a case of a young patient diagnosed with an atrial septal defect consistent with patent foramen ovale. Clinical presentation and diagnostic findings were analyzed, with particular attention to imaging modalities used in the evaluation of stroke etiology.
Results: Patent foramen ovale, although asymptomatic, may lead to serious embolic complications, including stroke. In young patients without traditional risk factors, without showing any visible symptoms, the condition may cause serious damage. The use of transesophageal echocardiography significantly improves detection of interatrial shunts and allows for accurate diagnosis of structural cardiac abnormalities and prevention of stroke in young patients.
Conclusions: Incorporating transesophageal echocardiography into the diagnostic workup of young patients prevents embolism from the foramen ovale. This approach can facilitate timely implementation of preventive strategies, including interventional closure, thereby reducing the risk of recurrent ischemic events, and should be added to screening protocols.

KEYWORDS

Patent Foramen Ovale, Stroke, Young Patient, Transesophageal Echocardiography, Prevention

CITATION

Krystyna Klahs, Kaja Nieradka, Maciej Muraszko-Kuźma, Patryk Twardy, Weronika Wagner, Jakub Białożyt, Anna Dębniak, Maciej Gutarowicz, Patryk Modelewski, Michał Armatys. (2026) Ischemic Stroke of the Brainstem with Involvement of the Oculomotor Nerve Nucleus as a Manifestation of a Persistent Foramen Ovale: a Case Report of a 40-Year-Old Patient. *International Journal of Innovative Technologies in Social Science*. 2(50). doi: 10.31435/ijitss.2(50).2026.5731

Introduction:

A patent foramen ovale (PFO) is the most common anatomical cause of an interatrial shunt, resulting from incomplete postnatal closure of the foramen ovale and is therefore regarded as a congenital heart defect [1,3]. Although it is typically asymptomatic and often detected incidentally, its clinical significance lies in the potential to enable paradoxical embolism. Through transient right-to-left shunting, embolic material may bypass the pulmonary circulation and enter the systemic arterial system, leading to serious complications such as ischemic stroke, myocardial infarction, or visceral and peripheral ischemia [1]. Given these risks, precise diagnostic evaluation is essential. Transesophageal echocardiography (TEE) remains a key imaging modality for confirming the presence of PFO, as it provides detailed visualization of the interatrial septum and allows detection of right-to-left shunting. Moreover, it may support the identification of cases in which embolic material has traversed the defect, contributing to peripheral arterial embolism [2]. In selected clinical situations, particularly in patients with a history suggestive of paradoxical embolism, invasive closure of the defect using an occluder device or surgical techniques is currently feasible and recommended. However, an important unresolved issue remains whether routine echocardiographic screening for PFO in asymptomatic individuals could be justified as a strategy for primary prevention. This constitutes a relevant research problem, as current evidence is insufficient to clearly determine the balance between potential benefits, risks, and cost-effectiveness, thereby highlighting the need for further studies [3].

All data used in this study were collected and processed in full compliance with applicable ethical standards and regulations concerning the protection of personal data. The information presented in this work has been thoroughly anonymized, and no elements that could directly or indirectly identify the participant have been disclosed. Any potentially identifiable details have been modified or omitted to ensure complete confidentiality while preserving the scientific value of the data. Prior to inclusion in the study, the participant was fully informed about the nature, purpose, and scope of the research, including the intention to use the collected data for scientific analysis and publication. The participant received clear and comprehensive

information regarding how the data would be handled, stored, and presented in an anonymized form. Written informed consent was obtained from the participant before any data collection took place. The consent explicitly covered the use of anonymized clinical information for research purposes, as well as permission for publication, including the description of the case in a scientific context. The data was included in the patient's records. The participant confirmed their understanding of the study procedures and voluntarily agreed to participate, with the right to withdraw consent at any stage without any consequences. All procedures performed in this study were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and relevant national guidelines, here is the quote that best conveys the essence of our work:„In medical research involving human participants capable of giving informed consent, each potential participant must be adequately informed in plain language of the aims, methods, anticipated benefits and potential risks and burdens, qualifications of the researcher, sources of funding, any potential conflicts of interest, provisions to protect privacy and confidentiality, incentives for participants, provisions for treating and/or compensating participants who are harmed as a consequence of participation, and any other relevant aspects of the research. The potential participant must be informed of the right to refuse to participate in the research or to withdraw consent to participate at any time without reprisal. Special attention should be given to the specific information and communication needs of individual potential participants as well as to the methods used to deliver the information. After ensuring that the potential participant has understood the information, the physician or another qualified individual must then seek the potential participant's freely given informed consent, formally documented on paper or electronically. If the consent cannot be expressed on paper or electronically, the non-written consent must be formally witnessed and documented. All medical research participants should be given the option of being informed about the general outcome and results of the research."[4]

Case report:

A 40-year-old previously healthy patient was admitted to the Department of Neurology due to the sudden onset of visual disturbances. The symptoms appeared abruptly in the morning on the day of admission and were primarily characterized by diplopia in the primary gaze position. The patient denied any preceding trauma, infection, headache, or systemic symptoms. There was no history of chronic diseases, genetically influenced illnesses, cardiovascular risk factors, or prior neurological events and the patient was not receiving any long-term pharmacotherapy. On initial neurological examination, the patient was conscious, fully alert, also oriented auto and allopsychically. Cranial nerve examination revealed bilateral exophthalmos and complex ocular motility disturbances. The patient reported persistent diplopia when looking straight ahead. On examination, a fine-wave nystagmus was observed on the right gaze, accompanied by opsoclonus. A marked limitation of vertical eye movements was present, involving both upward and downward gaze. Additionally, signs of paresis of the right oculomotor nerve (cranial nerve III) were noted. No abnormalities were found in the remaining cranial nerves. Motor examination showed no evidence of muscle weakness in the upper or lower extremities. Muscle tone was normal, and deep tendon reflexes were symmetrical. There were no pathological reflexes manifested. Sensory examination was unremarkable, and cerebellar testing did not reveal ataxia or coordination deficits. No meningeal signs were present. During hospitalization, repeated neurological examinations demonstrated persistence of diplopia and vertical gaze palsy, with no progression of neurological deficits. The clinical presentation suggested a lesion localized to the midbrain, particularly in the region of the oculomotor nerve nucleus. An ophthalmological consultation was performed to exclude primary ocular pathology. Visual acuity was normal in both eyes (1.0 bilaterally). Examination of the anterior segment revealed no abnormalities. Pupils were equal and reactive to light. Fundoscopic examination showed a normal optic disc and attached retina. Eye movement assessment confirmed normal motility in the right eye and limitation of upward gaze in the left eye. No indication for ophthalmological hospitalization was identified. A consultation in internal medicine confirmed that the patient was in a stable general condition. There were no signs of cardiopulmonary insufficiency. Slightly elevated arterial blood pressure was noted during hospitalization. Recommendations included outpatient monitoring of blood pressure as well as metabolic parameters, including glucose and glycated hemoglobin (HbA1c). A chest X-ray (PA projection) revealed no pathological findings. Computed tomography (CT) of the head, performed without contrast in the emergency setting, did not show any evidence of acute intracranial pathology, including hemorrhage or focal ischemic lesions. The ventricular system was symmetrical, and midline structures were preserved. Incidental findings included mucosal thickening in the maxillary sinuses suggestive of inflammation, as well as asymmetry of the sphenoid sinuses, more pronounced on the left side, likely of developmental origin. Given the inconclusive CT findings and the strong clinical suspicion of a brainstem lesion, magnetic resonance imaging (MRI) of the

brain was performed. MRI revealed a focal area of restricted diffusion measuring approximately 6 mm in diameter, located in the periaqueductal gray matter on the right side at the level of the superior colliculi of the tectal plate. The lesion corresponded anatomically to the region of the oculomotor nerve nucleus and was consistent with an acute ischemic infarction. No hemorrhagic transformation or pathological contrast enhancement was observed. Additionally, small chronic vascular lesions were noted in the white matter. In order to determine the etiology of the ischemic stroke, an extensive diagnostic workup was initiated. Doppler ultrasound of the carotid arteries demonstrated normal flow in the common, internal, and external carotid arteries bilaterally, with no evidence of significant stenosis or atherosclerotic plaques. Continuous ECG monitoring using a Holter device revealed sinus rhythm with an average heart rate of 70 beats per minute, without significant pauses or complex arrhythmias. Only a small number of supraventricular premature beats were recorded. Extensive blood work was performed, laboratory investigation was aimed at identifying prothrombotic conditions included assessment of protein C and protein S activity, antithrombin III levels, factor V Leiden mutation, prothrombin gene mutation, factor VIII activity, and homocysteine levels. All results were within normal limits, effectively excluding inherited or acquired thrombophilia. Due to the patient's relatively young age and the absence of conventional vascular risk factors, further cardiological evaluation was pursued. Transesophageal echocardiography (TEE) was performed and revealed the presence of a patent foramen ovale (PFO). The interatrial septum appeared thin and hypermobile. During the Valsalva maneuver with contrast administration (microbubble test), a significant right-to-left shunt was demonstrated, with a large number of microbubbles passing from the right to the left atrium. The identification of a PFO with a substantial shunt provided a likely explanation for the ischemic event, suggesting paradoxical embolism as the underlying mechanism of stroke. The patient was subsequently referred for percutaneous closure of the PFO. Following implementation of appropriate treatment and neuro-ophthalmological rehabilitation, the patient is advised to choose three practical exercises, allowing for the occurrence of an event. The treatment protocol includes several categories of exercises targeting different aspects of eye movement control. The first group focuses on vertical eye movements (looking up and down), performed in a controlled manner at timed intervals (e.g., 5 seconds per movement). This type of exercise is an additional element for soldiers with electric shock, as it aims to stimulate and gradually restore function in the event of occurrence on shock pathways. The second category includes eye exercises combined with pointing tasks, with external devices such as thumbs, or end devices such as sticks or pencils. These exercises aim to facilitate motor access and the access of proprioceptive stimuli. The third group consists of fixation exercises, in which specific directional criteria (horizontal, vertical, and diagonal) are observed, while simultaneously focusing on a single object, applied with a pencil. These tasks involve gaze range and precision. Additional program components include head movement exercises while maintaining fixation on a fixed point, as well as mirror practice. These exercises are designed to utilize frontal and ocular functions and provide visual feedback, which can enhance motor learning and correct movement patterns. Importantly, the program allows for the use of the left eye, right eye, or both eyes, based on the occurrence and side effects determined during the clinical evaluation. [Figure 1]. Gradual clinical improvement was observed. At the time of discharge, the patient continued to experience mild diplopia; however, there was noticeable improvement in ocular motility. The patient was able to perform most activities of daily living independently. At follow-up, the patient regained independence in most activities of daily living.

Methodology:

This study is a single-patient case report describing the clinical presentation, diagnostic process, and management of a 40-year-old patient with acute neurological symptoms and suspected embolic etiology. The report is based on a retrospective analysis of one clinical case. It aims to present the diagnostic pathway leading to the identification of patent foramen ovale (PFO) as a cause of ischemic stroke in a young patient without typical cardiovascular risk factors. Clinical data obtained from the patient’s medical records collected from medical history, neurological examination findings, and results of diagnostic procedures.

Results:

Neuroimaging studies revealed no abnormalities on initial computed tomography (CT) of the head, apart from asymmetry of the cavernous sinuses, more pronounced on the left side. However, subsequent magnetic resonance imaging (MRI) of the brain demonstrated acute ischemic lesions located in the periaqueductal gray matter on the right side at the level of the superior colliculi of the tectal plate. Evaluation of potential vascular causes of stroke showed no significant abnormalities. Carotid artery Doppler ultrasound revealed normal blood flow without evidence of hemodynamically significant stenosis. Continuous Holter electrocardiogram (ECG) monitoring did not detect any clinically relevant cardiac arrhythmias. Laboratory investigations aimed at identifying prothrombotic conditions, were all within normal ranges. Transesophageal echocardiography (TEE) revealed a flaccid interatrial septum. During contrast administration with the Valsalva maneuver, a significant right-to-left shunt was observed, with a large number of microbubbles passing through a patent foramen ovale (PFO). Based on the overall diagnostic evaluation and exclusion of other potential etiologies, PFO was identified as the most probable source of paradoxical embolism leading to the observed ischemic brain lesion. The patient was subsequently qualified for percutaneous PFO closure. Following treatment and rehabilitation [Figure 1], a partial clinical improvement was noted. Neurological examination demonstrated mild improvement in ocular motor function. At follow-up, the patient regained independence in most activities of daily living.

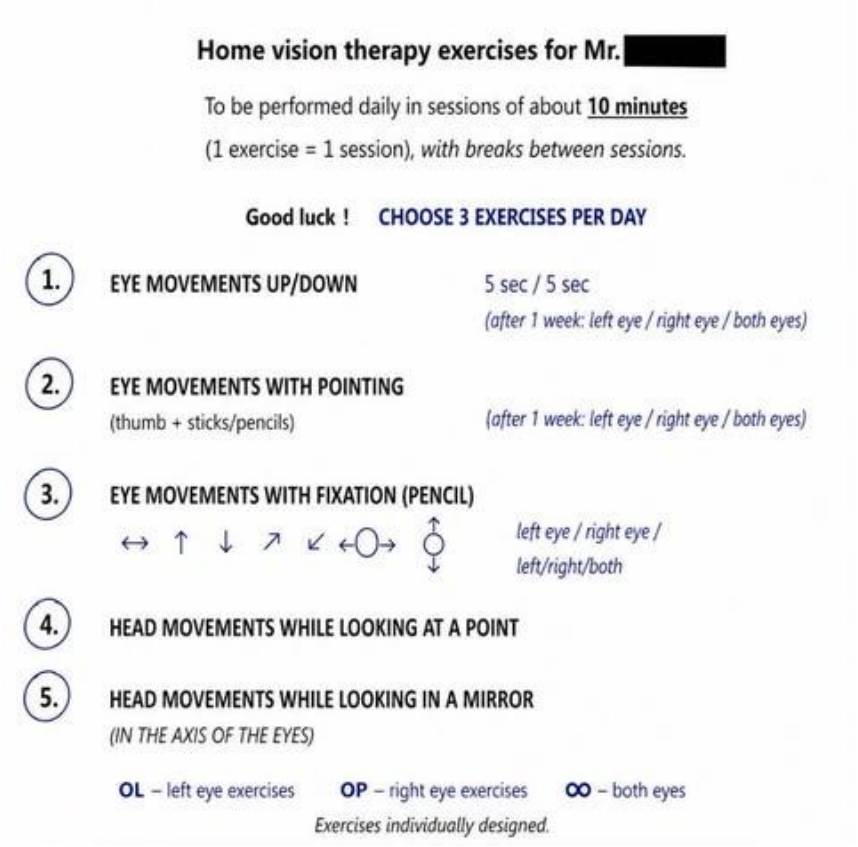

Figure 1. Home vision therapy exercises- this represents an individual vision therapy program prescribed by a trained specialist as part of neuro-ophthalmological rehabilitation for a patient with ischemic oculomotor nerve nucleus damage. The program is intended for home use and consists of structured, repetitive exercises aimed at improving eye mobility, coordination, and visual stability. The instructions specify that the exercises should be performed daily in sessions lasting approximately 10 minutes, with each session consisting of one exercise and short breaks between repetitions.

Discussion:

The presented case of a 40-year-old patient with an ischemic stroke of the brainstem that has an atypical oculomotor manifestation fits into the increasingly widely described relationship in the literature between the presence of a patent foramen ovale (PFO) and cryptogenic stroke in young individuals. In recent years, significant progress has been made in understanding the role of PFO as a potential source of paradoxical embolism and in defining the indications for its closure. Stroke in young adults often remains unexplained despite extensive diagnostics up to 30–40% of cases are classified as cryptogenic stroke. In this group of patients, the presence of PFO is detected more frequently than in the general population, which suggests its significant pathophysiological contribution. The mechanism of stroke is associated with a transient right-to-left shunt and the possibility of paradoxical embolism, particularly in situations of increased right atrial pressure. Confirmation of this relationship was provided by large randomized clinical trials published in 2017, such as RESPECT, CLOSE, and REDUCE [5]. A key impact on contemporary practice was made by the results of the RESPECT trial (2017), which demonstrated a significant reduction in the risk of recurrent ischemic stroke in patients undergoing PFO closure compared with conservative treatment [6]. Similar conclusions were drawn from the REDUCE trial (2017), which showed the superiority of percutaneous PFO closure over antiplatelet therapy in reducing the risk of recurrent stroke [6]. The CLOSE trial (2017) also confirmed the effectiveness of interventional treatment in patients at high risk (large shunt or atrial septal aneurysm) [7]. These findings were subsequently confirmed in meta-analyses, which demonstrated a significant reduction in the risk of stroke recurrence with PFO closure (RR approx. 0.42), particularly in younger patients and in cases of large right-to-left shunts. At the same time, attention was shifted to an increased risk of atrial fibrillation as a potential complication of interventional treatment [8]. In summary, the described case demonstrates the need to include transesophageal echocardiography (TEE) in screening examinations, as currently commonly used imaging studies are insufficient for detecting PFO, and its early qualification for interventional treatment reduces the risk of stroke.

Conclusions:

The presented case of a 40-year-old patient with an ischemic stroke involving the oculomotor nerve nucleus on the right side, manifesting as vertical gaze disturbances and nystagmus on lateral gaze, and a patent foramen ovale, highlights significant limitations of standard diagnostic screening for cardiovascular diseases. In this patient, despite performing routine examinations such as carotid artery Doppler ultrasound and Holter ECG monitoring, no clear cause of the ischemic event was identified. Only transesophageal echocardiography (TEE) enabled the detection of a patent foramen ovale (PFO) with a significant right-to-left shunt, which had a direct impact on the occurrence of ischemic stroke at a young age. In view of the globally increasing incidence of cardiovascular diseases, including embolic strokes, it appears justified to expand the screening panel to include transesophageal echocardiography. TEE remains the method with the highest sensitivity and specificity in the diagnosis of interatrial septal pathologies, such as PFO, which are undetectable in standard non-invasive examinations. Early use of transesophageal echocardiography significantly shortens the time to establish the correct diagnosis, enabling the implementation of targeted treatment, including percutaneous interventions, which translates into a reduction in the risk of stroke at a young age, especially in the era of the increasing prevalence of cardiovascular diseases affecting the population on an ever larger scale.Therefore, it is reasonable to advocate for further well-designed studies on this topic, with the aim of providing definitive evidence on the clinical value and cost-effectiveness of PFO detection.This is especially relevant in younger patients presenting with cryptogenic ischemic stroke, where early identification of an underlying embolic source has direct therapeutic implications. Incorporating TEE into selected screening tests could facilitate earlier diagnosis, enable timely initiation of targeted interventions such as percutaneous PFO closure, and ultimately contribute to reducing the risk of recurrent cerebrovascular events. In the context of the rising global burden of cardiovascular disease and stroke, a more proactive diagnostic approach that includes TEE may improve clinical outcomes and should be further evaluated in prospective, well-designed studies assessing its cost-effectiveness and impact on long-term prognosis.

REFERENCES

1. Alakbarzade, V., Keteepe-Arachi, T., Karsan, N., Ray, R., & Pereira, A. C. (2020). Patent foramen ovale. *Practical Neurology, 20*(3), 225–233. https://doi.org/10.1136/practneurol-2019-002450
2. Sroczyńska, P. A., Kuderska, N., Gołda, J., Mężyk, J., Snopkowska, A., Jurga, M., & Jurga, K. (n.d.). *Crossed embolism as a manifestation of patent foramen ovale based on a case of a 45-year-old patient*.
3. Rizzo, S., De Gaspari, M., Basso, C., Fraccaro, C., & Thiene, G. (2025). Patent foramen ovale: A variant of normal or a true congenital heart disease? *Cardiovascular Pathology, 76*, 107722. https://doi.org/10.1016/j.carpath.2025.107722
4. World Medical Association. (2024). *WMA Declaration of Helsinki: Ethical principles for medical research involving human participants*.
5. Wiktor, D. M., & Carroll, J. D. (2018). *The case for selective patent foramen ovale closure after cryptogenic stroke*.
6. Kumbhani, D. J. (2017). *Patent foramen ovale closure or antiplatelet therapy for cryptogenic stroke—REDUCE PFO*.
7. Cooke, W. (2025). *A review of evidence for surgical closure versus medical therapy alone in preventing recurrent stroke in the presence of a patent foramen ovale*.
8. Hakeem, A., Cilingiroglu, M., Katramados, A., Boudoulas, K. D., Iliescu, C., Gundogdu, B., & Marmagkiolis, K. (2018). Transcatheter closure of patent foramen ovale for secondary prevention of ischemic stroke: Quantitative synthesis of pooled randomized trial data.