PATENT FORAMEN OVALE AND ISCHAEMIC STROKE IN YOUNG ADULTS – A RETROSPECTIVE STUDY

ROK ARH[1], MARIJA MENIH[2], LUCIJA JAZBEC[1]

[1]University of Maribor, Faculty of Medicine, Maribor, Slovenia; [2]Maribor University Medical Centre, Maribor, Slovenia[2]

Objective: Ischaemic stroke is the most common type of stroke. One of the risk factors is patent foramen ovale (PFO), which is normally open in parallel intrauterine circulation and represents the right-to-left flow (shunt), and is closed by the septum primum tissue or persists after establishment of postpartum circulation. If it does not close at the end of the first year, it is called atrial septal defect (ASD) and represents left-to-right flow in circulation. This defect remains open with varying degrees of left-to-right flow in some patients. It is thought to be present in about 50% of young patients who experience ischaemic stroke. It is caused by the mechanism of paradoxical embolization, but by the right-to-left flow. The factors affecting the likelihood of stroke in these patients are as follows: PFO size, increase in the right atrial pressure due to various factors that may transiently cause right-to-left flow, or even open virtually closed fossa ovalis. A possible concomitant aneurysm of the interatrial septum at the level of fossa ovalis has a special place in the development of paradoxical embolism. The accompanying factors that increase the likelihood of ischaemic stroke in patients with PFO are severe physical exertion, agitation, pulmonary hypertension, immobilisation, pregnancy, and congenital or acquired coagulation disorders. *Methods:* This retrospective study was based on the analysis of patients aged 18-49 years hospitalised due to ischaemic stroke at the Maribor University Medical Centre in the period from 2010 to 2019 inclusive. Differences between the 2 groups were analysed. Group 1 consisted of patients with proven PFO and group 2 of patients in whom no right-to-left flow was demonstrated. The results of the research were analysed by JASP 0.14.1. and IBM SPSS Statistics 28 software. The level of statistical significance was set at $p<0.05$. *Results:* This study included 196 patients with 198 ischaemic stroke events. PFO was present in 23 (11.7%) patients. Arterial hypertension was more common in group 2 patients (17.4% vs. 53.2%, $p<0.05$). Group 1 patients were significantly younger than group 2 patients (36.478 (7.223) vs. 42.214 (7.043) years, $p<0.05$). Disease outcome was more favourable in group 1 as compared with group 2 patients (1.000 (0.603) vs. 1.728 (1.574), $p<0.05$). *Conclusions:* Persistent foramen ovale is a more common cause of ischaemic stroke in younger people and plays a key role in this age group. Arterial hypertension is probably a more common cause of ischaemic stroke in elderly patients. The outcome of the disease is more favourable in the group of patients with PFO.

Key words: ischaemic stroke, patent foramen ovale, young adults, risk factors, paradoxical embolism

Address for correspondence: Rok Arh
Faculty of Medicine, University of Maribor
Taborska ulica 8
2000 Maribor, Slovenia
E-mail: rok.arh@student.um.si

Rok Arh (https://orcid.org/0000-0003-3275-8409)
Marija Menih (https://orcid.org/0000-0002-9381-6222)
Lucija Jazbec (https://orcid.org/0000-0002-1232-6740)

INTRODUCTION

Ischaemic stroke (IS) is the most common type of stroke. It accounts for 71% of all strokes. It is one of the most common causes of death and disability (1). Ischaemic stroke in young adults is usually defined as an IS which occurs in adults aged between 18 and 50 years. Some studies include patients aged up to 55 years. It occurs in 7-8/100,000 people in Europe and up to 100/100,000 people in Sub-Saharan Africa. Even though IS in young adults is not as common as in older population, it still represents 10%-18% of all IS cases (2-4). The incidence of IS in young adults continues to increase in higher-income countries (5).

Although patients may have different causes of IS, the cause still remains undetermined in 40% of cases (6,7). These cases are referred to as cryptogenic stroke. In these patients, it is important to pursue a stroke mechanism to be able to choose an improved therapy op-

tion in order to reduce the stroke recurrence risk (8). Most cryptogenic strokes appear to be embolic, thus the term embolic stroke of undetermined source (9).

Atrial septumis formed during embryogenesis by two membranes growing from the atrial walls, leaving an oval shaped fenestration (foramen ovale), which serves as a right-to-left shunt in the foetal circulation. It is sealed during the first year of life by fusion of both membranes. The failure of this process leads to an interatrial slit-like channel, called patent foramen ovale (PFO) (10). It is present in 20%-30% of general population. Studies report that the percentages of PFO presence tend to be even higher in people with cryptogenic IS (11,12). Some report that the percentage could be near 50% in young patients (12). In these cases, IS occurs as a consequence of paradoxical embolization. Criteria for paradoxical embolization include proven arterial infarction, absence of embolus in left heart, proof of venous thrombosis or pulmonary embolism, and right-to-left shunt (11,12). The occurrence of IS may be influenced by PFO size, shunt flow, tunnel length and PFO accompanied by atrial septum aneurysm. Accompanying factors that increase the probability of IS in patients with PFO are immobilization, pregnancy, congenital and acquired hypercoagulable conditions (6,13). PFO has also been associated withrecurrent IS cases (5).

Although most of the times PFO does not cause any problems, it has been associated with cryptogenic stroke, migraine, peripheral embolism, and Alzheimer's dementia (10). On the other hand, many cases of PFO in patients with IS also represent incidental findings and are not the cause of the event (14).

Considering PFO treatment, most studies imply that PFO closure on its own does not affect the prevalence of recurrent stroke (15,16). Other studies report that PFO closure in addition to medical therapy appears to be cost-effective compared to medical therapy alone (17).

AIM

The study was conducted to determine the incidence of PFO in young adults who had suffered an IS and to compare risk factors for stroke in patients with this heart malformation to risk factors of patients without PFO.

METHODS

This retrospective study was based on data on all patients who were hospitalised at the Maribor University Medical Centre due to IS during the period from 2010 and 2019 inclusive. Included patients were aged 18-49 inclusive at the time of the event. If a single person suffered more than one stroke event in the monitoring time, the second event was considered as a relapse. Individuals who did not meet the time or age interval criteria were excluded. Patients who suffered other types of strokes, e.g., haemorrhagic stroke or venous sinus thrombosis, or were hospitalised due to other causes, were also excluded.

The study was approved by the Ethics Committee of the Maribor University Medical Centre in Maribor, Slovenia (UKC-MB-KME-45/21).

In this study, we compared characteristics of patients with proven PFO (group 1) with characteristics of patient group without it (group 2). Only patients with a sonographically confirmed PFO or PFO history were included in group 1.Patients with PFO had it confirmed with transoesophageal echocardiography (TEE). Echocardiography was performed either during hospitalisation or on an outpatient basis after discharge but noted in the discharge letter.

Data were obtained from the MEDIS hospital database. Alongside the information on PFO, the data contained information on patient gender, age, location of the lesion according to circulation, year of hospitalisation, duration of hospitalisation, relapse, National Institutes of Health Stroke Scale (NIHSS) score at admission, NIHSS score at discharge, difference between both scores, modified Rankin Scale (mRS) score (measured at discharge), and risk factors for ischaemic stroke, such as family history, obesity, experience of transient ischaemic attack (TIA), arterial hypertension, diabetes mellitus and HbA1c, dyslipidaemia, migraine, malignant disease, infection, alcohol use, smoking cigarettes, illicit drug abuse, pregnancy, hormonal therapy, immunosuppressive therapy, immunoglobulin therapy, Down syndrome, Marfan syndrome, morphological heart abnormalities (heart or ascending aorta aneurysm, myxoma, heart valve changes, heart hypertrophy, heart dilatation), heart congestion, heart rhythm disorders, increased value of homocysteine, decreased values of vitamins D and B12, folates, protein C, protein S, factor V Leiden mutation, prothrombin gene mutation, presence of antibodies (anti-b2GPI-IgG,anti-b2GPI-IgM, anti-b2GPI-IgA, anti-cardiolipin-IgG, anti-cardiolipin-IgM, cryoglobulins, myeloperoxidase, ANCA, ANA, ENA, anti-SS-A, anti-SS-B, anti-Sm, anti-RNP, anti-Jo-1, anti-Scl-70, anti-dsDNA, lupus anticoagulant), and primary central nervous system angiitis.

Events that occurred in patients with clinical presentation of stroke in the past were marked as relapses. Lesions in the carotid artery, anterior or medial cerebral

artery or their branches were classified as 'anterior circulation'. Lesions in the posterior cerebral artery, basilar or vertebral artery or their branches were classified as'posterior circulation'. Those with an IS or TIA in parents or siblings were considered to have a positive family history. The group with a positive family history was divided into three subgroups depending on the time of event occurrence (before the age of 50, at 50 or later) and an undefined group of patients, whose age at the event was unknown. The days spent at the Maribor University Medical Centre were considered as the length of hospital stay. Obesity was defined by body mass index ≥30. The group of people with diabetes was divided into a group of patients with type 1 diabetes and a group with patients with type 2 diabetes. Normal HbA1c values were determined as NGSP<6.0% and IFCC <42 mmol/L. Dyslipidaemia was considered as values of total cholesterol >5.7 mmol/L, high-density lipoprotein (HDL) <0.9 mmol/L, low-density lipoprotein (LDL) >4.9 mmol/L or triglycerides (TG) >1.7 mmol/L. Malignant diseases of any type within five years prior to the event were considered as malignant diseases. In the group of infectious diseases, the events with clinically or laboratory proven infection during hospital stay or a week prior to the event were taken in consideration. Alcohol consumption was divided into groups of harmful drinking and occasional drinking. Smoking was considered as regular smoking of cigarettes at the time of the event or in the past. Oral contraceptives, therapy with sex hormones and erythropoietin therapy were considered as hormonal therapy. Heart rhythm disorders were divided into two groups of atrial fibrillation and other rhythm disorders. Increased homocysteine was determined at values above 15 μmol/L, decreased vitamin D at values below 47.7 nmol/L, decreased vitamin B12 at values <132 pmol/L, decreased folates at values <6.1 nmol/L, and decreased protein C and protein S at values <70 IU/dL. Disease outcome was determined by NIHSS and mRS scales.

The results of the research were analysed by JASP 0.14.1. The level of statistical significance was set at $p<0.05$. The values of skewness and kurtosis between -2 and 2 were used to evaluate the normality of distribution.

RESULTS

Among 196 patients with 198 IS events, who were included in the study, PFO was found to be present in 23 (11.7%) patients included in the study. In 2011 and 2015, there was one case each, in 2014, 2016, 2018 and 2019 there were three cases, in 2017 four, and in 2013 there were five cases of IS with PFO. Thirteen (56.5%) patients with PFO were men, who also predominated in the group of patients without PFO, accounting for 66.5% of the patients included in the study.

None of the patients with PFO suffered from diabetes mellitus, increased HbA1c, malignant disease, Down syndrome, Marfan's syndrome, arterial dissection, arteriovenous malformations, myxoma or infection. None of them were illicit drug users, pregnant or taking immunoglobulin therapy. None of them had *decreased* vitamin Dor B12, folates, or protein C levels. There was no case of factor V Leiden mutation in the PFO group. None of these patients died in the hospital.

Five (21.7%) out of 23 PFO patients were obese compared to 25 (14.5%) out of 173 patients in the non-PFO group. There were 2 (8.7 %) relapse cases in the PFO group and 18 (10.4 %) in the non-PFO group. Only one (4.3%) patient in the PFO group had a medical history of TIA prior to IS, and 17 (9.8%) patients in the non-PFO group had a history of TIA. In both groups, a more common location of lesion was anterior circulation. In the PFO group,15 (65.2%) cases of IS occurred in anterior circulation, 6 (26.1%) in posterior, and two (8.7%) cases in both circulations concomitantly. In the non-PFO group, 110 (63.6%) cases of IS occurred in anterior circulation, 60 (34.7%) in posterior, and 3 (1.7%) in both circulations. Out of 23 PFO patients, 16 (69.9%) had no family history of IS or TIA, two (8.7%) had relative suffering from an ischaemic cerebrovascular event before age 50, four (17.4%) had relative suffering from an ischaemic cerebrovascular event after age 50, and one (4.3%) patient had relative suffering with an ischaemic cerebrovascular event that occurred at unknown age.

In the PFO group, four (17.4%) patients had a medical history of arterial hypertension, while in the non-PFO group arterial hypertension was present in 92 (53.2%) patients. In the PFO group, 12 (52.2%) patients had dyslipidaemia, two (8.7%) suffered from migraine, three (13.0%) consumed alcohol moderately, and 20 (87.0%) patients did not consume alcohol at all. Six (26.1%) PFO patients were smokers, four (17.4%) used hormonal therapy, two (8.7%) were on immunosuppressive therapy, one (4.3%) patient had a heart aneurysm or ascending aorta aneurysm, one (4.3%) had heart valve *abnormality*, two (8.7%) had heart hypertrophy, one (4.3%) had heart dilatation, and one (4.3%) had heart congestion. None of the patients in this group had atrial fibrillation; however, five (21.7%) of them had other heart rhythm disorders.

Among PFO patients, two (8.7%) had elevated homocysteine levels, four (17.4%) had decreased protein S levels, and one (4.3%) had a prothrombin gene mutation. Frequencies of risk factors are presented in Tables 1, 2 and 3.

Table 1. *Risk factors for ischaemic stroke in patients with and without patent foramen ovale (PFO): Gender, Obesity, Arterial Hypertension, Dyslipidaemia, positive family history*

		Gender		Obesity		Arterial hypertension		Dyslipidaemia		Positive family history	
		male	female	no	yes	no	yes	no	yes	no	yes
		Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
PFO	**no**	66.5%	33.5%	85.5%	14.5%	46.8%	53.2%	42.2%	57.8%	93.6%	6.4%
	yes	56.5%	43.5%	78.3%	21.7%	82.6%	17.4%	47.8%	52.2%	69.6%	30.4%

Table 2. *Risk factors for ischaemic stroke in patients with and without patent foramen ovale (PFO): Alcohol consumption, Migraine, Smoking, elevated homocysteine levels, decreased protein S levels*

		Alcohol		Migraine		Smoking		Elevated homocysteine		Decreased protein s	
		no	yes	no	yes	no	yes	no	yes	no	yes
		Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
PFO	**no**	68.8%	31.2%	94.8%	5.2%	62.4%	37.6%	96.5%	3.5%	91.9%	8.1%
	yes	87.0%	13.0%	91.3%	8.7%	73.9%	26.1%	91.3%	8.7%	82.6%	17.4%

Table 3. *Risk factors for ischaemic stroke in patients with and without patent foramen ovale (PFO): Prothrombin gene mutation, Hormonal therapy, Immunosuppressive therapy, Structural heart malformations*

		Prothrombin mutation		Hormonal therapy		Immunosuppressive therapy		Structural heart malformations	
		no	yes	no	yes	no	yes	no	yes
		Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %	Row N %
PFO	**no**	98.8%	1.2%	95.4%	4.6%	96.5%	3.5%	77.5%	22.5%
	yes	95.7%	4.3%	82.6%	17.4%	91.3%	8.7%	8.7%	91.3%

Echocardiography after the event was performed in 137 (69.9%) study patients; 62.8% of these had transthoracic echocardiography (TTE), 3.6% had TEE,and 33.6% had both. It was performed either during hospital stay or on an outpatient basis.

Mean (SD) age of IS patients with PFO was 36.478 (7.223) years compared to 42.214 (7.043) in the non-PFO group with IS. Median (interquartile range, IQR) length of hospital stay was 15.000 (8.500) in the PFO group and 18.000 (16.000) in the non-PFO group. Mean (SD) NIHSS at admission was 4.435 (4.273) in PFO patients and 6.295 (4.833) in the non-PFO group. At discharge, median (IQR) value of NIHSS was 1.000 (2.000) in the PFO group and 2.000 (3.000) in the non-PFO group. Median (IQR) difference between both NIHSS values was -2.000 (4.000) in the PFO group compared to -2.000 (5.000) in the non-PFO group. Mean (SD) mRS at discharge was 1.000 (0.603) in IS patients with PFO compared to 1.728 (1.574) in the IS group without PFO.

Relations between the variables mentioned above and the presence of PFO were statistically analysed. PFO patients with IS were less likely to suffer from arterial hypertension than non-PFO patients $\chi^2(1)=10.405$, p=0.001. Median (IQR) age of patients who suffered from hypertension was 46.00 (5.25), and our study showed that hypertension was significantly more common in older patients (U=2796.000, p<0.001). The research also showed that patients with PFO were more likely to be younger than non PFO-patients (T=3.659, p<0.001).

Although NIHSS values, both at admission and at discharge, tend to be more favourable in patients with PFO, our study showed it to be statistically nonsignificant. mRS values at discharge tended to be lower (and therefore more favourable) in PFO patients than in non-PFO patients (T=2.193, p=0.029).

DISCUSSION

Considering all IS patients included in this study, PFO was found in 11.7% of them, which is lower than most researches show, as it is reported to be present in up to 50% of young adult patients with IS (11,12,17). It might be due to a reason that almost one-third of all patients did not undergo echocardiography; some of them had it done outside Maribor UMC, and some did not respond to the invitation to do it on an outpatient basis. In some cases, it was not performed because the

diagnosis was clear (e.g., arterial dissection). Some studies show that PFO is present in 13.6% (18) or even in 20%-30% of general population (11,12).

There were more men than women with PFO in our research; however, it was not statistically significant because there were more male patients in the study. Other studies confirm that more male than female young adults suffer from IS with PFO (19).

The study also showed that the mean age of stroke patients with PFO was lower compared to the mean age of IS patients without PFO. According to other studies, PFO appears to be a more important risk factor in younger patients, i.e., IS patients younger than 40 (20,21). Our study indicated that IS patients with PFO were less likely to have a medical history of arterial hypertension. This is due to the fact that arterial hypertension plays a more important role as a risk factor for IS in older population, where all other traditional risk factors also play a more significant role in the IS pathogenesis than in young adults.The relation between age and arterial hypertension was also verified in this study and it appears to be statistically significant. Hypertension is more likely to appear in older patients, while PFO is usually found in younger patients. Another study points to the fact that PFO patients have a lower atherosclerotic burden compared to non-PFO patients suffering from IS (22).

Stroke patients with PFO seem to have a significantly better outcome than other young adults with IS, which has been confirmed in other studies (23). This might be due to younger age, less comorbidities, and milder clinical presentation (NIHSS).

CONCLUSION

Patent foramen ovale is an important factor that plays a vital role in some IS pathogenesis cases, especially in young adults. Therefore, it should be considered in young adults with IS presentation who lack traditional and modifiable risk factors. PFO solely cannot be the only risk factor for stroke; it is a common finding in general population and it requires a hypercoagulable state to increase the risk of paradoxical embolism with consequences (e.g., IS). We found that arterial hypertension appeared to be more common in IS not caused by PFO. In addition, we observed that IS patients with PFO tended to be younger than non-PFO patients and have a better outcome according to mRS. More studies on risk factors associated with PFO are needed to further research the impact of PFO on IS probability in an individual, as the results of many studies tend to be contradictory.

There were some limitations to our study; to begin with, sampling was carried out by convenience. The study was based on a Caucasian population. Moreover, the sample was very small, which resulted in limited statistical analyses; some of the expected values were small; this may have led to the p-value not being accurate. The study was retrospective, i.e., data could not have been collected directly from patients, instead medical database findings were used. Some data might be inaccurate due to their subjective nature and the inability to verify such data, e.g., medical history of smoking, using illicit drugs, and alcohol abuse.

REFERENCES

1. Campbell BCV, De Silva DA, Macleod MR *et al*. Ischaemic stroke. Nat Rev Dis Prim 2019; 5(1): 1-22.

2. van Alebeek ME, Arntz RM, Ekker MS *et al*. Risk factors and mechanisms of stroke in young adults: The FUTURE study. J Cereb Blood Flow Metab 2018; 38(9): 1631-41.

3. Tejada Meza H, Artal Roy J, Pérez Lázaro C *et al*. Epidemiology and characteristics of ischaemic stroke in young adults in Aragon. Neurologia 2019; 56(13): 1437-42.

4. Siriratnam P, Godfrey A, O'Connor E *et al*. Prevalence and risk factors of ischaemic stroke in the young: a regional Australian perspective. Intern Med J 2020; 50(6): 698-704.

5. Schneider S, Kornejeva A, Vibo R, Kõrv J. Risk factors and etiology of young ischemic stroke patients in Estonia. Stroke Res Treat 2017; 2017: 8075697.

6. Putaala J. Ischemic stroke in young adults. Vol. 26, Continuum Lifelong Learning in Neurology. Lippincott Williams and Wilkins, 2020, 386-414.

7. Maaijwee NAMM, Rutten-Jacobs LCA, Schaapsmeerders P, Van Dijk EJ, De Leeuw FE. Ischaemic stroke in young adults: risk factors and long-term consequences. Vol. 10, Nature Reviews Neurology. Nature Publishing Group 2014; 10: 315-25.

8. Yaghi S, Elkind MSV. Cryptogenic stroke: a diagnostic challenge. Neurol Clin Pract 2014; 4(5): 386.

9. Kamel H. The evolving concept of cryptogenic Stroke Continuum (Minneap Minn) 2020; 26(2): 353-62.

10. Ioannidis SG, Mitsias PD. Patent foramen ovale in cryptogenic ischemic stroke: direct cause, risk factor, or incidental finding? Front Neurol 2020; 0: 567.

11. Pretnar-Oblak J. Ishemična možganska kap pri mladih. Med Razgl 2014; 53(3): 335-46. (in Slovene)

12. Mesa D, Franco M, Suárez de Lezo J *et al*. Prevalencia de foramen oval permeable en pacientes jóvenes con accidente isquémico cerebral de causa desconocida. Rev Española Cardiol 2003; 6(7): 662-8. (in Spanish)

13. Turc G, Lee JY, Brochet E *et al*. Atrial septal aneurysm, shunt size, and recurrent stroke risk in patients with patent foramen ovale. J Am Coll Cardiol. 2020; 75(18): 2312-20.

14. Thaler D, Saver J. Cryptogenic stroke and patent foramen ovale. Curr Opin Cardiol 2008; 23(6): 537-44.

15. Mono ML, Geister L, Galimanis A *et al*. Patent foramen ovale may be causal for the first stroke but unrelated to subsequent ischemic events. Stroke 2011; 42(10): 2891-5.

16. Mirzada N, Ladenvall P, Hansson PO, Eriksson P, Dellborg M. Recurrent stroke in patients with patent foramen ovale: an observational prospective study of percutaneous closure of PFO versus non-closure. Int J Cardiol 201; 195: 293-9.

17. Pickett CA, Villines TC, Resar JR, Hulten EA. Cost effectiveness and clinical efficacy of patent foramen ovale closure as compared to medical therapy in cryptogenic stroke patients: a detailed cost analysis and meta-analysis of randomized controlled trials. Int J Cardiol 2018; 273: 74-9.

18. Kuramoto J, Kawamura A, Dembo T *et al*. Prevalence of patent foramen ovale in the Japanese population – autopsy study. Circ J 2015; 79(9): 2038-42.

19. Şenadim S, Bozkurt D, Çabalar M, Bajrami A, Yayla V. The role of patent foramen ovale in cryptogenic stroke. Noro Psikiyatr Ars 2016; 53(1): 60-3.

20. Webster MWI, Smith HJ, Sharpe DN *et al*. Patent foramen ovale in young stroke patients. Lancet 1988; 332(8601): 11-2.

21. Jeanrenaud X, Bogousslavsky J, Payot M, Regli F, Kappenberger L. Patent foramen ovale and cerebral infarct in young patients. Schweiz Med Wochenschr 1990; 120(22): 823-9.

22. Rodés-Cabau J, Noël M, Marrero A *et al*. Atherosclerotic burden findings in young cryptogenic stroke patients with and without a patent foramen ovale. Stroke 2009; 40(2): 419-25.

23. Chang J, Chiem T, Alderazi Y, Chapple K, Restrepo L. Clinical outcomes after intravenous fibrinolysis in cryptogenic strokes with or without patent foramen ovale. J Stroke Cerebrovasc Dis 2013; (8): 492-9.

SAŽETAK

PERZISTIRAJUĆI OVALNI OTVOR *(FORAMEN OVALE)* I ISHEMIJSKI MOŽDANI UDAR U MLADIH OSOBA − RETROSPEKTIVNO ISTRAŽIVANJE

R. ARH[1], M. MENIH[2], L. JAZBEC[1]

[1]Sveučilište u Mariboru, Medicinski fakultet, Maribor, Slovenija; [2]Univerzitetski medicinski centar Maribor, Maribor, Slovenija

Pozadina: Ishemijski moždani udar je najčešći tip moždanog udara. Jedan od čimbenika rizika jest perzistirajući ovalni otvor (engl. patent foramen ovale, PFO) koji je normalno otvoren u paralelnoj intrauterinoj cirkulaciji i predstavlja desno-lijevi pretok (shunt), a nakon postpartalne uspostave serijske cirkulacije zatvara se tkivom septuma primuma ili perzistira. Ako se ne zatvori završetkom prve godine naziva se defektom septuma atrija (engl. atrial septal defect, ASD) i u serijskoj cirkulaciji predstavlja lijevo-desni pretok. Ovaj defekt ostaje otvoren s različitim stupnjem lijevo-desnog pretoka u dijela bolesnika. Smatra se da je prisutan u oko 50 % mladih bolesnika koji dožive ishemijski moždani udar. Uzrokovan je mehanizmom paradoksalne embolizacije, ali desno-lijevim pretokom. Čimbenici koji utječu na vjerojatnost moždanog udara kod ovih bolesnika su sljedeći: veličina PFO, porast tlaka u desnoj pretklijetki zbog različitih čimbenika koji mogu u tim posebnim okolnostima prolazno izazvati desno-lijevi pretok ili čak otvoriti virtualno zatvorenu ovalnu fosu nepotpuno sraštenom preklopnicom (flap). Posebno mjesto u nastanku paradoksalne embolije ima moguća popratna aneurizma interatrijskog septuma na razini ovalne fose. Popratni čimbenici koji povećavaju vjerojatnost ishemijskog moždanog udara kod bolesnika s PFO su teži tjelesni napori, uzbuđenje, plućna hipertenzija, ali i imobilizacija, trudnoća te prirođeni ili stečeni poremećaji koagulacije. ***Metode:*** Riječ je retrospektivnoj studiji analize bolesnika u dobi od 18 do 49 godina hospitaliziranih zbog ishemijskog moždanog udara u razdoblju od 2010. do 2019. godine u UKC Maribor. Analizirane su razlike između dviju skupina: skupina 1 s dokazanim PFO u odnosu na skupinu 2 kod koje nije dokazan desno-lijevi pretok na razini ovalne fose. Analiza je provedena pomoću programa JASP 0.14.1. i IBM SPSS Statistics 28. Za statističku značajnost korištena je granična vrijednost p<0,05. ***Rezultati:*** U ovo istraživanje bilo je uključeno 196 bolesnika sa 198 događaja ishemijskog moždanog udara. PFO bio je prisutan u 23 (11,7%) bolesnika. ***Rezultati:*** Arterijska hipertenzija bila je češće prisutna u bolesnika u skupini 2 (17,4 % : 53,2 %, p<0,05); bolesnici skupine 1 bili su značajno mlađi od bolesnika skupine 2 (36,478 (7.223) : 42,214 (7.043) godina, p<0,05); ishod bolesti bio je povoljniji u bolesnika skupine 1 nego u skupini 2 (1,000 (0,603) : 1,728 (1,574), p<0,05). ***Zaključak:*** Perzistirajući ovalni otvor je češće uzrok ishemijskog moždanog udara kod mlađih osoba te ima ključnu ulogu u toj dobnoj skupini. Arterijska hipertenzija je vjerojatno češći uzrok ishemijskog moždanog udara u starijih bolesnika. Ishod bolesti je povoljniji u skupini bolesnika s PFO.

Ključne riječi: ishemijski moždani udar, perzistirajući ovalni otvor, mlade osobe, čimbenici rizika, paradoksalna embolija