JMedSci

Journal of the Medical Sciences
(Berkala Ilmu Kedokteran)

Volume 54, Number 2, 2022; 125-131
http://dx.doi.org/10.19106/JMedSci005402202203

Analysis of systemic risk factors of occipital stroke-related vision loss

Indra Tri Mahayana*, Nyssa Alexandra Tedjonegoro, Tatang Talka Gani

Department of Ophthalmology, Faculty of Medicine, Public Health, and Nursing Universitas Gadjah Mada/Dr. Sardjito General Hospital, Yogyakarta, Indonesia

Submitted: 2022-01-09
Accepted : 2022-02-12

ABSTRACT

Occipital stroke is associated with visual field defects and other visual perceptual deficits that might lead to detrimental effects on health-related quality of life. This study aimed to evaluate the possible association between systemic risk factors and the features of occipital stroke. It was a retrospective observational study involving patients diagnosed with occipital stroke in Dr. Yap Eye Hospital, Yogyakarta, Indonesia, between 2013 and 2014. A total of 72 patients with occipital stroke proven with CT/MRI who underwent detailed evaluation of ocular and systemic risk factors were included in this study. The patients were divided into two groups with or without risk factors. The risk factors were hypertension, diabetes mellitus, and cardiac diseases. The effect of risk factors on sex, age groups (≤40, >40 and ≤60, >60 years old), stroke lesions (left occipital, right occipital, bilateral), and visual field defects (homonymous hemianopia, homonymous quadrantanopia, and others) were analyzed. Out of 72 patients, there were 56 males (77.8 %), and 16 females (22.2 %), with a mean age of 58.46 ± 11.83 years old. The study found a significant difference in age with risk factors compared with those without risk factors (p = 0.025), as well as visual acuity with age groups (p = 0.005) and stroke lesions (p = 0.024). Analysis of risk factors showed that hypertension was significantly correlated with stroke lesions, whereas cardiac disease was significantly associated with age groups (p<0.05). Predictive analysis was performed using a linear regression model, and it showed that risk factors could predict the occurrence of stroke lesions. In conclusion, patients' systemic risk factors are significantly associated with the older onset of occipital stroke and lower visual acuity, although not significantly associated with stroke location and visual field defect characteristics.

ABSTRAK

Stroke oksipital berhubungan dengan defek pada bidang visual dan defisit persepsi visual lainnya yang dapat merugikan kualitas hidup yang berkaitan dengan kesehatan. Penelitian ini bertujuan untuk mengkaji hubungan antara faktor risiko sistemik dan karakteristik stroke oksipital. Penelitian ini merupakan penelitian retrospektif observasi pada pasien dengan stroke oksipital yang berobat di RSM Dr. Yap, Yogyakarta, Indonesia, pada tahun 2013 sampai 2014. Total sebanyak 72 pasien stroke oksipital yang dibuktikan dengan CT/MRI dan menjalani evaluasi faktor risiko okuler dan sistemik secara detail dilibatkan dalam penelitian. Pasien dibagi menjadi dua kelompok, yaitu kelompok dengan faktor risiko (hipertensi, diabetes mellitus, dan penyakit jantung) dan tanpa faktor risiko. Pengaruh faktor risiko pada jenis kelamin, kelompok usia (≤40, >40 - ≤60, >60 tahun), lesi stroke (oksipital kiri, oksipital kanan, bilateral), dan defek lapang pandang (hemianopia homonim, quadrantanopia homonim, dan lain-lain) dianalisa. Dari 72 pasien, 56 laki-laki (77,8%) dan 16 perempuan (22,2%) dengan usia rata-rata 58,46 ± 11,83 tahun. Terdapat perbedaan nyata pada usia dengan faktor risiko dibandingkan tanpa faktor risiko (p = 0,025), dan juga pada ketajaman penglihatan pada kelompok usia (p = 0,005) dan lesi stroke (p = 0,024). Analisa faktor risiko menunjukkan bahwa hipertensi berhubungan bermakna dengan lesi stroke, sedangkan penyakit jantung secara bermakna berhubungan dengan kelompok usia (p< 0,05). Analisa prediktif dilakukan menggunakan model regresi linear. Analisa tersebut menunjukkan bahwa faktor risiko dapat menentukan keberadaan lesi stroke. Kesimpulan, faktor risiko sistemik yang dimiliki pasien berhubungan dengan onset stroke oksipital yang lebih lama dan ketajaman visual yang lebih rendah, namun tidak berhubungan dengan lokasi stroke dan karakteristik defek bidang visual.

Keywords:
aging;
neuro-ophthalmology;
occipital stroke;
visual acuity;
visual cortex

*corresponding author: tri.mahayana@gmail.com

INTRODUCTION

Stroke is a common problem in the elderly that leads to significant disability. Although most patients have no other neurological deficits aside from visual-field defects, occipital stroke has significant impacts on their quality of life, which include changes to independent living, ability to drive, loss of confidence, and some links to depression.[1-3]

The most common cause of occipital lobe infarct is posterior cerebral artery (PCA) ischemia, also known as posterior circulation ischemic stroke, which is caused by a cardiac embolism and blocked local artery to artery sources.[4] Cardiac disease is the most common source of embolism (41%), and patients with a cardiac source of an embolism usually have pure PCA infarcts (81%).[5] Vascular disease due to hypertension and diabetes mellitus may be the main underlying cause of stroke.[6-8] A study by Subramanian[9] in 2009 reported that diabetes mellitus is associated with the increased odds of posterior circulation ischemic stroke. This study is supported by Kim *et al*. in 2012, who found that hypertension and diabetes mellitus were more related to posterior than anterior circulation ischemic stroke.[10]

Occipital stroke is associated with visual field damage with detrimental effects on health-related quality of life.[3] The PCA infarction may lead to homonymous hemianopia (HH) and other visual perceptual deficits, which is expected since it creates damage to the areas responsible for the central visual pathway.[11,12]

This study aimed to evaluate the association of systemic risk factors i.e. hypertension, cardiac disease, and diabetes mellitus and the characteristics of occipital stroke such as patients' age, visual loss, visual field defects, and stroke laterality.

SUBJECTS AND METHODS

Design and study population

This retrospective observational study used the medical records of occipital stroke patients who came to the outpatient clinic at Dr. Yap Eye Hospital between January 2013 and December 2014.

Protocol of study

The diagnosis of occipital stroke was performed through clinical examinations (complete ophthalmic evaluation: visual acuity, anterior segment examination, funduscopy, and visual field examination) by an ophthalmologist and then continued by reviewing the results of imaging modalities such as computerized tomography (CT)-scan, magnetic resonance imagery (MRI), or both, performed by the radiologists.

Basic characteristics of patients and systemic risk factors (hypertension, diabetes mellitus, and cardiac diseases) were collected from the medical records. The laterality and location of the stroke in the occipital cortex were also recorded for analysis. Visual acuity was assessed at a fixed distance with the Snellen chart, and the visual field examination used Goldmann kinetic perimetry. Patients with pre-existing ophthalmological problems were excluded, such as cataracts, glaucoma, retinopathy, or other ocular pathologies that may affect the visual field. The study was conducted in accordance with the Declaration of Helsinki. The institutional ethics board of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia, approved the study and waived individual consent for this retrospective analysis by issuing the ethical clearance number KE/FK/0749/EC/2017.

Statistical analysis

Statistical analysis was performed using the IBM SPSS Statistic for Windows Version 20.0 (IBM Corp. Armonk, NY, USA). The patients were divided into two groups with (hypertension, diabetes mellitus, and cardiac diseases) or without risk factors. The effect of risk factors on sex, age groups (≤40, >40 and ≤60, >60 years old), stroke lesions (left occipital, right occipital, bilateral), and visual field defects (HH, homonymous quadrantanopia, and others) were analyzed using Chi-square tests, whereas age and visual acuity were analyzed using independent t-tests if the data distribution was normal. The association between stroke lesions and visual acuity were analyzed using one-way Anova followed by post-hoc analysis. Predictive analysis using linear regression models was performed to predict the possibility of systemic risk factors affecting the stroke lesions and the visual field defects. A value of $p < 0.05$ was considered statistically significant.

RESULTS

A total of 72 patients (mean age 58.46 ± 11.83 years) were included in this study with 56 males (77.8 %) and 16 females (22.2 %). TABLE 1 describes the subjects' characteristics, which indicate almost half of the subjects had a right occipital lesion (45.05%). The most frequent visual field defect in patients with occipital stroke was hemianopia (69.44%). Data showed that most patients had hypertension (61%) as their main risk factor for occipital stroke.

TABLE 1. Characteristic of subjects

Variables	Number
Sex [n (%)]	
▪ Male	56 (77.8)
▪ Female	16 (22.2)
Age (mean ± SD years)	58.46 ± 11.83
Visual acuity (mean ± SD dec)	0.37 ± 0.35
Stroke lesions [n (%)]	
▪ Left occipital	24 (33)
▪ Right occipital	31 (45.05)
▪ Bilateral	10 (13.88)
▪ Others	7 (9.72)
Visual field defects [n (%)]	
▪ Hemianopia	50 (69.44)
▪ Quadrantanopia	10 (13.88)
▪ Others	12 (16.67)
Risk factors [n (%)]	
▪ Hypertension	44 (61.10)
▪ Diabetes mellitus	22 (30.60)
▪ Cardiac disease	9 (12.50)

TABLE 2 shows the association of sex, age, and visual acuity with the presence of systemic risk factors. The visual acuity of the right eye (VOD) was significantly correlated with age groups (F=5.630, p=0.005). In comparison, the visual acuity of the left eye (VOS) was not (F=2.036, p=0.138) (TABLE 3). Post hoc pairwise comparisons (Bonferroni adjusted) showed a significant difference between the two age groups: ≤40 years old versus >60 years old (p=0.012). Significant results were also observed between the locations of stroke lesions and the visual acuity for both eyes (VOD (F=3.338, p=0.024) and VOS (F=3.682, p=0.016)). Post hoc pairwise (Bonferroni adjusted) comparison was significant on VOD and VOS for left occipital stroke versus bilateral occipital stroke (p=0.039 and p=0.023, respectively).

TABLE 2. The correlation of subject characteristics with the presence of systemic risk factors

Variables	Without risk factors (n=15)	With risk factors (n=57)	p
Sex [n (%)]			
▪ Male	10 (66.67)	46 (80.7)	0.245
▪ Female	5 (33.33)	11 (19.3)	(OR:0.478, CI:0.136-1.684)
Age (mean ± SD years)	52.4 ± 16.22	60.05 ± 9.95	0.025
▪ ≤40	2 (13.33)	1 (1.75)	
▪ >40 and ≤60	9 (60)	31 (54.38)	0.093*
▪ >60	4 (26.67)	25 (43.85)	
VOD (mean ± SD)	0.54 ± 0.37	0.32 ± 0.33	0.028*
VOS (mean ± SD)	0.51 ± 0.36	0.34 ± 0.35	0.090

Note: Sex was analyzed by Chi-square test; Age, VOD, and VOS (shown in decimal) were analyzed by independent samples t-tests; visual acuity: means ± standard deviation; *significant (p<0.05); CI= confidence interval.

TABLE 3. Risk factors analyses based on laterality of the stroke and visual field defects

Variables	Without risk factors (n=15)	With risk factors (n=57)	p
Stroke lesions [n (%)]			
▪ Left occipital	5 (33.33)	19 (33.33)	
▪ Right occipital	8 (53.33)	23 (40.35)	0.715
▪ Bilateral	1 (6.67)	9 (15.78)	
▪ Others	1 (6.67)	6 (10.53)	
Visual field defects [n (%)]			
▪ Hemianopia	11 (73.3)	39 (68.42)	
▪ Quadrantanopia	3 (20)	7 (12.28)	0.430
▪ Others	1 (6.67)	11 (19.33)	

Note : p value : Chi-square tests

TABLE 4 shows the analysis of the risk factors based on stroke characteristics. The results showed that there were no significant differences observed. Spearman's correlation of risk factors and stroke lesions, visual field defects, and age groups showed that hypertension had a significant correlation with stroke lesions (r= 0.317, p=0.007), the cardiac disease had a significant correlation

with age groups (r= 0.288, p=0.014), and diabetes mellitus had marginally significant correlation with visual field defects (r=-0.199, p=0.095). Furthermore, predictive analysis using a linear regression model of stroke lesions and risk factors showed that risk factors could predict the stroke lesions (R^2 = 0.102, p=0.049), where hypertension was the most common systemic risk factor (t=2.610, p=0.011). However, the visual field defects did not have a significant result (diabetes mellitus and visual field defects: t= -1.749, p=0.085).

TABLE 4. The correlation of systemic risk factors, visual field defects, and age groups

Systemic risk factors	r	p
Hypertension	0.317	0.07
Cardiac disease	0.288	0.014*
Diabetes mellitus	-0.199	0.095

*significant (p<.05)

DISCUSSION

This study found that patients with risk factors were associated with older age and lower visual acuity, but it was not associated with stroke laterality and visual field defect characteristics. Previous studies revealed that patients with hypertension and diabetes mellitus were more significantly associated with posterior circulations stroke.[9,10] Although the contribution of systemic risk factors might be combined with the occurrence of a specific condition such as vertebral artery hypoplasia.[13]

The significant difference in visual acuity between right and left occipital stroke was presumably due to coincidence since occipital stroke might not affect visual acuity. However, this finding was in line with a study conducted by Rowe *et al.*,[14] which also mentioned that this asymmetry might affect patients' ability to read in the future. This study also found that sex was not associated with systemic risk factors. On the contrary, age groups and visual acuity were associated with risk factors in which older age had more underlying systemic diseases and lower visual acuity. A study conducted by Naess *et al.*,[15] revealed that occipital infarction was associated with younger patients. Although occipital stroke may not create any changes to visual acuity, further detailed visual acuity analyses showed associations of visual acuity with the location of occipital stroke lesions (TABLE 3). The visual acuity of patients with bilateral lesions and involvement of parietal or temporal lesions were lower compared to patients who only have unilateral occipital stroke lesions. This finding showed that there might be other underlying risk factors. Poor visual acuity is a risk factor for falls and a common impediment to rehabilitation.[16,17] After a stroke, visual impairment may exacerbate the impact of other impairments on overall disability.[16,17]

TABLE 4 shows there was no association between stroke lesions and visual field defects with the underlying risk factors. Hypertension and diabetes mellitus might create an effect on the development of stroke-associated visual field defects, although the frequency distribution analysis of risk factors based on visual field defects was not statistically significant. However, predictive analysis using linear regression showed that systemic risk factors could predict the occurrence of stroke lesions, with hypertension being the most frequently

found factor. This finding shows that vascular factors, such as hypertension, might be one of the significant risk factors in the occurrence of occipital stroke.

Rowe *et al*.[14] found that cortical strokes which are associated with visual field loss, particularly in the occipital, temporal, and parietal lobes, were mainly caused by PCA infarcts. Infarcts on PCA's territory are common, and their clinical signs and symptoms are well-known.[18,19] Occipital strokes may produce HH visual field defects although, other visual field defects such as quadrantanopia (HQ) and other defects might occur due to lesions affecting the occipital white matter or defects with the adjacent temporal or parietal area, such as occipitotemporal and occipitoparietal lesions.[1,14] Lack of visual field improvement is the most accurate prediction for the high risk of cortical blindness. Ischemic stroke due to occipital lobe lesions causes most HH, which generally does not produce any other neurologic manifestations. The HH configuration does not predict the location of the lesion within the retrochiasmal visual pathway.[18]

There are several limitations in this study. First, this is not a population-based prospective study. Therefore, it is not possible to analyze the improvement and treatment outcome of patients with occipital stroke over time. Second, the results and conclusions should be interpreted cautiously due to the small sample size. With a larger sample population, some marginally trending results could become more significant. Further, a larger number of patients and a population-based study are needed to disclose the association of occipital stroke more accurately with certain risk factors.

CONCLUSION

Risk factors are associated with older patients and lower visual acuity, although they are not associated with stroke location and visual field defect characteristics. Younger patients might suffer from an occipital stroke that is not underlined by systemic risk factors, and therefore, further study is important to investigate the exact mechanism of occipital stroke.

ACKNOWLEDGEMENTS

The authors declare no conflict of interest regarding this paper's publication. The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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