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Research Article

Demographic and Clinical Characteristics of Patients with and Without Vascular Dementia Following an Ischemic Stroke

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Abstract

Introduction: Vascular dementia (VaD) is one of the most common causes of dementia in the elderly (those over the age of 65), with a variable presentation and unpredictable disease progression. Current evidence indicates that 25-30% of ischemic stroke patients are likely to develop either immediate or delayed vascular cognitive impairment, or VaD. The development of dementia following a stroke is determined by several factors.

Materials and methods: This study involved 100 patients with ischemic stroke, treated and evaluated for 2 years at the University Clinic of Neurology in Skopje, Republic of North Macedonia, divided into two groups: a group of 47 patients who developed vascular dementia after an ischemic stroke (study group) and a group of 53 patients with ischemic stroke who did not develop vascular dementia (control group).

Results: According to the results of this study, the gender and age differences between the two groups are not statistically significant. Also, there is no statistically significant difference between the affected hemisphere and the appearance or absence of vascular dementia during the evaluation period of two years following the ischemic stroke. On the other hand, a statistically significant difference was found when comparing the distribution of patients with a positive diagnosis for clinically relevant stenosis of one or both carotid arteries with the presence of vascular dementia. No statistically significant difference was found between the representation of four of the five factors (arterial hypertension, diabetes type 2, hyperlipidemia, history of tobacco use) and the occurrence or absence of vascular dementia. Contrary to this, the presence of specific cardiovascular diseases highlights an obvious link with the occurrence of vascular dementia.

Conclusions: Monitoring the risk of vascular disease and preventing recurrent strokes are obviously essential for reducing the burden of cognitive decline and vascular dementia.

Keywords: Vascular Dementia; Ischemic Stroke; Vascular Risk Factors; Clinical Investigations; Comorbidities

Introduction

Dementia is a developing and predominantly irreversible clinical syndrome, including general impairment of mental function, which presents as issues in memory, language, interests in daily living, and psychosocial and psychiatric interference [1]. The three most frequent dementia subgroups are Alzheimer's disease (AD), vascular dementia (VaD), and combined dementia (between AD and VaD pathology) [2]. Vascular dementia, second only to Alzheimer's disease, is one of the most common causes of dementia in the elderly (those over the age of 65), with a variable presentation and unpredictable disease progression [3]. The approximate prevalence of this disease is 1.6% [4] in Europe and 1.7% [5] in China. VaD is more common in males than in females, according to studies from general community populations, but most studies found no significant gender difference in the risk of dementia after stroke [6]. This type of dementia, which is frequently associated with a stroke in the left hemisphere, has an impact on reasoning, planning, judgment, memory, and other thought processes [7].

Current evidence indicates that 25-30% of ischemic stroke patients are likely to develop either immediate or delayed vascular cognitive impairment, or vascular dementia. The development of dementia following a stroke is determined by several factors, including the precise location and extent of the stroke, the degree of related neuronal damage, the likelihood of pre-existing cognitive impairment or other cerebral pathology, and the current age of the patient [8]. The immediate effect of any particular genetic factor(s) is unknown. However, the genetic susceptibility estimate for all ischemic strokes is 38%, but it varies significantly by subtype, with the greatest associated with large vessel (40%) and cardioembolic disease (33%), and the lowest associated with small vessel (16%) disease [9]. The cognitive domains involved in the development of dementia after a stroke are also variable depending on stroke characteristics such as stroke category, volume, size, place, and level of severity. In terms of stroke type, patients with ischemic strokes typically have higher survival rates than those with hemorrhagic strokes, which explains why ischemic strokes cause more behavioral disorders than hemorrhagic strokes [10].

As well, the risk of developing vascular dementia increases with age, roughly doubling every five years. Hyperlipidemia, arterial hypertension, diabetes, and tobacco use are all risk factors for its development [6,11].

The purpose of this paper is to show the demographic and clinical characteristics of patients who had a stroke and later developed vascular dementia, as well as patients who had a stroke but did not develop vascular dementia.

Materials and Methods

Participants

This study involved 100 patients with ischemic stroke, objectified by anatomy-morphological methods: computer tomography (CTM) and/or magnetic resonance imaging (MRI). Colour Doppler ultrasound examination and electroencephalography (EEG) were also performed. The patients were treated and evaluated for 2 years at the University Clinic of Neurology in Skopje, Republic of North Macedonia, divided into two groups

- A group of 47 patients who developed vascular dementia after an ischemic stroke (study group)
- A group of 53 patients with ischemic stroke who did not develop vascular dementia (control group)

Inclusion criteria for the study group

- Documented ischemic stroke using anatomo-morphological methods (CT and/or MRI on the brain, Doppler carotid artery sonography).
- Vascular dementia (documented with neuropsychological testing and criteria of MCB 10 and DSM IV), for a period of at least 2 years after a stroke.

Exclusion criteria for the study group

- Patients with aphasia
- Other disease with a life expectancy of less than 2 years
- Hepatic dysfunction

Inclusion criteria for the control group

- Documented ischemic stroke with anatomo-morphological methods (CT and/or MRI on the brain, Doppler carotid artery sonography)

Exclusion criteria for the control group:

- Development of any cognitive impairment or dementia over a period of 2 years after the stroke
- Hepatic dysfunction

Statistical analysis

Statistical analyses were performed using the software plugins XLSTAT 2016 and Real Statistics 2016 installed on Microsoft Excel 2016. Descriptive statistical methods were applied with a tabular and graphical presentation of data and results, while attributive series were analyzed by determining the coefficients of relationships, proportions, frequencies, and the statistical significance of the differences. Continuous values were analyzed with the Student's t-test if they followed a normal distribution determined with the Shapiro-Wilk test; on the contrary, the non-parametric Mann-Whitney test was used. Unless otherwise stated, all the above statistical tests are two-way. For significant interference values at p less than 0.05 and for highly significant values at $p < 0.01$.

Ethical Considerations

The Ethical Committee of the University Hospital of Neurology in Skopje, North Macedonia, approved the study.

Results

Gender structure

A total of 100 patients with documented ischemic stroke were included in the study, with 53 men and 44 women. This suggests a nearly equal gender distribution, with a slightly higher presence of male individuals. Compared to the group of patients with vascular dementia, the control group has a slightly higher percentage of male participants. The distribution of male and female sexes in both groups is fairly balanced, as shown by the statistically insignificant gender differences between the vascular dementia group and the control group ($p > 0.05$).

Age structure

The age range of the patients with recorded strokes in our study is 45-84 years, with an average age of 67 years (standard deviation = 8,77). The table shows the age distribution of the control group, the vascular dementia group, and all patients. The age differences between the two groups are not statistically significant ($p > 0.05$), which suggests that the adult structure is well-balanced.

Gender	All subjects		Vascular dementia group		Control group		Differences between groups with vascular dementia group and control group[#]	
	n	%	N	%	n	%	x^2	*p*
Male	53	53,00	24	51,06	29	54,72	0,133	0,715
Female	47	47,00	23	48,94	24	45,28		
Total	100	100,00	47	100,00	53	100,00		

Table 1: Gender distribution in vascular dementia patients and controls.

[#]Pearson two-tailed x^2-test; critical value for this analysis is: 3.84.

Variables	All subjects	Control group	Vascular dementia group	Differences between groups with vascular dementia group and the control group[#]
	N = 100	N = 53	N = 47	*p*
Average age	67,17	65,74	68,79	0,106
Youngest age	45	45	45	
Oldest age	84	84	83	
Standard deviation	8,77	9,47	7,69	

Table 2: Age distribution in vascular dementia patients and controls.

[#] two-tailed Mann-Whitney test.

Clinical investigations

Table 3 illustrates data on the affected hemisphere according to CT findings, the presence of pathological changes on the EEG, as well as the findings of clinically relevant carotid artery stenosis in the two groups of patients with a history of documented ischemic stroke.

Variable		Control group (n = 53)		Vascular dementia group (n = 47)		Two-tailed Fisher's exact test	Two-tailed Mantel-Haenszel test
		n	%	n	%	*p*	*p*
Affected hemisphere	Right	22	41.51	16	34.04	0.609	0.644
	Left	24	45.28	22	46.81		
	both sides	7	13.21	9	19.15		
EEG changes		11	20.75	7	14.89	0.603	
Ultrasound measurement of the carotid stenosis		27	50.94	38	80.85	0.003*	

Table 3: Data for relevant findings from clinical investigations in both groups.

*statistically significant.

Clinically relevant comorbidities

Variabile	Control group (n = 53)		Vascular dementia group (n = 47)		Two-tailed Fisher's exact test	Two-tailed Mantel-Haenszel test$
	n	%	n	%	p	p
Arterial hypertension	46	86.79	42	89.36	0.669	1.000
Diabetes mellitus type 2	23	43.40	25	53.19	0.869	
Hyperlipidemia	27	50.94	23	48.94	48.94	
Cardiovascular diseases	20	37.74	29	61.70	0.027*	
History of tobacco use	26	49.06	24	51.06	0.870	

Table 4: Data for comorbidities and other relevant characteristics in both groups.

*Statistically significant

$two-tailed Mann-Whitney test

Discussion

Stroke, the third leading cause of death, is thought to be a major cause of long-term disability and cognitive impairment. This requires massive resources from healthcare systems [12]. Older age is the most significant risk factor for stroke throughout life. Both men and women experience steep increases in incidence as they age. Even though the risk for a child under the age of 15 is one in 100,000, it is one in 33 for people aged 85 and over. The rate of stroke more than doubles every decade from the age of 55 to 84 and beyond [13]. The most treatable risk factor for ischemic stroke is high blood pressure. It represents a golden opportunity for stroke prevention and reduction of the burden of post-stroke cognitive impairment [8].

Dementia after stroke is thought to be a clinical entity that includes any type of dementia that occurs following stroke injury, regardless of whether it includes vascular, neurodegenerative, or mixed processes. A large number of stroke survivors who have a suitable clinical diagnosis of dementia and a neuropsychometric evaluation develop VaD [14]. In addition to the elevated risk of stroke with age, older age is the most significant risk factor for vascular dementia [14].

According to the American Stroke Association [7], vascular dementia is frequently associated with a stroke in the left hemisphere. On the other hand, the results of this study show that there is no statistically significant difference between the affected hemisphere, the presence of EEG abnormalities on one side, and the appearance or absence of vascular dementia during the evaluation period of two years following the ischemic stroke ($p > 0.05$). Contrarily, a statistically significant difference was found when comparing the distribution of patients with a positive diagnosis for clinically relevant stenosis of one or both carotid arteries identified by colour Doppler ultrasonography examination with the presence of vascular dementia ($p < 0.01$).

The most common variable risk factor for stroke is hypertension. Higher systolic and diastolic blood pressures are associated

with an increased risk of stroke and, consequently, stroke-related dementia, with hypertension duration serving as an important predictor [13]. Also, when diabetes is present, people with hypertension are at an increased risk of stroke and cognitive impairment [13]. Other risk factors for developing dementia after stroke include cardiac arrhythmias and congestive heart failure. When vascular comorbid conditions exist, the risk of vascular dementia increases. Thus, hypertension, atrial fibrillation, diabetes, myocardial infarction, and congestive heart failure can frequently coexist in different levels [15]. Also, in a variety of pathological mechanisms involved in the development of VaD, lipids have a vital role in many of these processes. Both high levels of low-density lipoprotein (LDL) cholesterol and low levels of high-density lipoprotein (HDL) cholesterol are recognized risk factors for coronary artery disease and carotid atherosclerosis [16].

Regarding this study results, no statistically significant difference was found between the representation of four of the five factors (arterial hypertension, diabetes type 2, hyperlipidemia, history of tobacco use) and the occurrence or absence of vascular dementia in the examined patients during the 2-year evaluation period after ischemic stroke ($p > 0.05$). Contrary, the presence of specific cardiovascular diseases, such as coronary artery disease with all of its consequences, heart weakness, various types of rhythm disturbances, valvular disease, and other clinical conditions, which are represented by nearly half of all 100 subjects in the study, highlights an obvious link with the occurrence of vascular dementia. In other words, the distribution of patients with cardiovascular diseases shows a statistically significant difference between the control group and the group with vascular dementia with Fisher's exact test ($p < 0.05$).

Experiment studies have contributed significantly to our current understanding of the ischemic injury cascade. The cascade is a complex series of highly heterogeneous events that develop over minutes, days, and weeks following the initial hypoperfusive event. Energy failure due to blood flow disruption, excitotoxicity, calcium overloading, oxidative stress, blood-brain barrier (BBB) dysfunction, microvascular injury, hemostatic activation, injury-related inflammation and immune responses, and cell death involving neurons, glia, and endothelial cells serve as the principal moments [17]. According to experimental findings, neuronal death after ischemic injury is primarily caused by necrosis. Recent research suggests that significant cell death occurs via apoptotic and hybrid mechanisms (e.g., necroptosis) along an apoptosis-necrosis continuum [18]. Also, neuroinflammation and immunodepression are also linked to stroke, aging, and infection. These are most likely detrimental to cognitive function after a stroke [19].

Conclusions

When comparing the distribution of patients with a positive diagnosis for clinically relevant stenosis of one or both carotid arteries with the presence of vascular dementia, a statistically significant difference was found. Furthermore, there is clear evidence linking the occurrence of certain cardiovascular diseases to the development of vascular dementia. Cognitive impairment is common in various populations following an ischemic stroke injury. Monitoring the risk of vascular disease and preventing recurrent strokes are obviously essential for reducing the burden of cognitive decline and thus, vascular dementia.

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Conflicts of Interest

The authors declare no conflict of interest.

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