

Age Features of Chronic Cerebrovascular Insufficiency in Some forms of Dysplasia of Cerebral Arteries

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Abstract

Background: The purpose of this study was to examine the age-related characteristics of chronic cerebrovascular insufficiency (CCVI) in patients with various forms of cerebral artery dysplasia, as well as to analyze gender differences. **Methods:** Sixty-one patients were examined, of whom 20 were young adults (mean age 32.1 ± 2.0 years). The control group consisted of 41 middle-aged and elderly patients (mean age 57.7 ± 0.74 years). The study used paraclinical diagnostic methods to evaluate neurological symptoms and determine the type of cerebral artery lesion based on age.

Results: Hemodynamically significant changes were more often observed in deformities such as vessel inflexion at an acute angle, rather than in hypo- or aplasias. Pathological deformity (PD) and stenosis were also frequently observed in combination, contributing to the development of CCVI of varying severity. Young adult patients were more likely to experience migraine-like headaches, particularly men, while motor disorders, limb numbness, and dizziness were common in middle-aged and elderly patients. In young patients, angiodysplasias in the form of hypo- or aplasias without PD in the internal carotid artery (ICA) were often asymptomatic and congenital. PDs of the ICA were observed in middle-aged and elderly patients with stages III and IV of CCVI, developing throughout their lives in the context of hypertension, atherosclerosis, and other vascular diseases.

Conclusions: The study reveals that age and gender play a significant role in the development and manifestation of CCVI in patients with cerebral artery dysplasia. The findings highlight the importance of proper diagnosis and management of CCVI based on the patient's age and gender.

Keywords: chronic cerebrovascular insufficiency; dysplasia of cerebral arteries; age characteristics; diagnosis.

1. Introduction

Chronic cerebrovascular insufficiency (CCVI) refers to a specific type of cerebral vascular pathology characterized by gradual, diffuse insufficiency of blood supply to the brain tissue, leading to a decline in brain function [7]. Despite advances in medical research, cerebrovascular diseases remain relevant due to their increasing prevalence and life-threatening complications such as stroke, which can result in significant disability

and reduced quality of life [2, 10, 13, 14]. Anatomical variations in the internal carotid artery (ICA) are common and can be identified using ultrasound and angiography. Neuroimaging techniques such as magnetic resonance imaging of the brain are also useful for visualizing acute cerebrovascular disorders and white matter changes that confirm a vascular origin of brain lesions [5, 8, 9].

Pathology of the major cerebral vessels is a common risk factor for CCVI, with pathological deformation (PD) of ICA being the second leading cause of ischemic stroke [7, 10]. The incidence of PD in ICA is higher in patients with concomitant arterial hypertension, which increases the risk of transient ischemic attacks [15]. An unclosed Willis circle, a serious anatomical anomaly, is associated with various types of cerebral circulation disorders, with anterior disconnection occurring in 3-4% of cases and posterior disconnection occurring in 6.8-25% of cases [12]. Neurological symptoms of cerebrovascular insufficiency may manifest as pathological tortuosity of the carotid arteries, affecting up to 16% of subjects [11]. PD of ICA is also linked to hypoplasia and PD of vertebral arteries in both children and adults [4]. Linear blood flow velocity and wall shear stress in ICA decrease with age, which can lead to cerebrovascular insufficiency in 40% of patients under the age of 40 with PD of ICA [3]. Therefore, it is important to evaluate neurological symptoms and identify types of cerebral artery lesions based on patient age.

2. Methods

The study involved 61 patients, of whom 20 were aged between 19 and 45 years, with a mean age of 32.1 ± 2.0 years. The remaining 41 patients served as the control group and were of middle to old age, ranging from 46 to 75 years, with a mean age of 57.7 ± 0.74 years. Neurological symptoms were evaluated using MRI of the brain in angio-regimen and duplex scanning of brachiocephalic vessels. Duplex scanning was performed on 50 patients, MRI-angio regimen on 21 patients, and MSCT angiography on 25 patients. Pathological tortuosity of extracranial arteries was treated with reconstructive surgery in 34 patients, while conservative treatment was administered to the remaining patients, including antioxidants, metabolics, blood rheology improving agents, and cerebroprotectors. In 22 (69%) cases, pathological tortuosity of carotid arteries was accompanied by their stenosis. The main group consisted of 13 (65%) men (mean age 33.2 ± 1.8 years) and 7 (35%) women (mean age 31.2 ± 1.0 years), while the control group consisted of 18 (44%) men (mean age 59.8 ± 1.2 years) and 23 (56%) women (mean age 56 ± 0.89 years) (Figure 1).

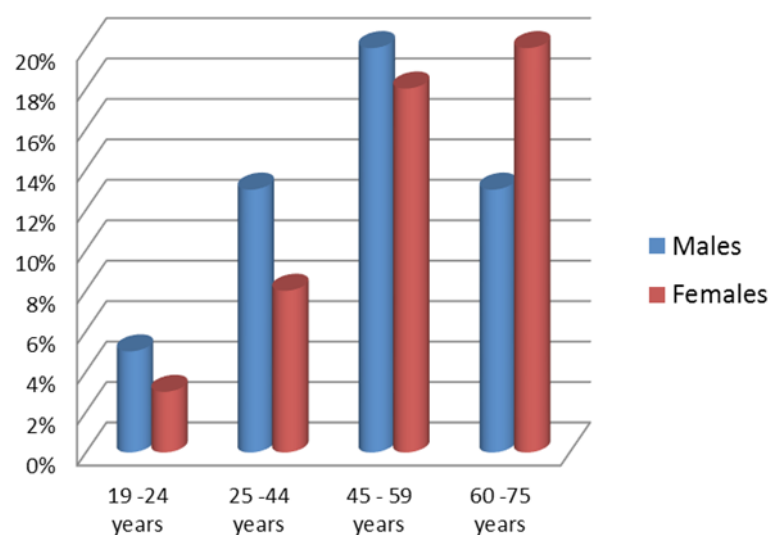


Figure 1. Age and gender gradation of patients with chronic cerebrovascular insufficiency

The statistical analysis of the obtained data was performed using standard software from the "Microsoft Excel-2007" analysis package, utilizing evidence-based medicine indicators such as OR (relative risk) and *P (Fisher exact test). The normal distribution of numerical data was assessed, and selective arithmetic mean (M) and

selective mean standard error (deviation) (m) were determined. The results are presented as $M \pm m$. Pearson's chi-squared test (χ^2) was used to analyze statistically significant differences between qualitative features.

3. Results

Pathological tortuosity in the form of loop formation was detected only in 1 (3%) patient of the control group when using the declared diagnostic methods of investigation (Table 1). The incidence of inflexion at an acute angle was found in 6 (43%) patients of the main group and in 15 (44%) patients of the control group. S- and C-shaped crimps were observed in 2 (14%) patients of the main group and 9 (26%) patients in the control group. It is worth noting that in 22 (65%) cases of the control group, pathological tortuosity was combined with stenosis.

Hypoplasia of intracranial arteries, as observed through MRI angiography, was more frequently observed in patients of the main group, with 10 (48%) cases compared to the control group, which had only 3 (14%) cases ($\chi^2 = 4.0$, $P = 0.06$, $OR = 2.5$). In MSCT angiography, PD was more frequently combined with angiodyplasia of the intracranial arteries, particularly with intracranial arterial hypoplasia in the main group with 3 (12%) patients, while in the control group, it was noted twice as often with 6 (24%) patients ($\chi^2 = 0.5$, $P = 0.4$, $OR = 0.5$). Isolated occurrences of PD of extracranial arteries were more frequently observed in the control group, with 5 (20%) patients compared to only 1 (4%) case in the main group ($\chi^2 = 0.0005$, $P = 1.0$, $OR = 1.2$).

Table 1. – Findings of MRI in angioregimen and MSCT angiography for determination varieties of cerebral arteries lesions, depending on age.

Findings of MRI in angioregimen n=21	Main group Young age	Control group Middle and old age
1	2	3
Hypoplasia of intracranial arteries	10 (48%)	3 (14%)
Aplasia of intracranial arteries	2 (10%)	1 (5%)
Vascular encephalopathy without cerebral angiodyplasia	–	5 (23%)
Total	21 (100%)	
Findings of MSCT angiography n = 25		
Aplasia of intracranial arteries	–	1 (4%)
Pathological deformation of extracranial arteries in combination with hypoplasia of intracranial arteries	3 (12%)	6 (24%)
Pathological deformation of extracranial arteries in combination with aplasia of intracranial arteries	1 (4%)	4 (16%)
Pathological deformation of extracranial arteries in combination with hypoplasia and aplasia of intracranial arteries	–	4 (16%)
Pathological deformation of extracranial arteries	1 (4%)	5 (20%)
Total	25 (100%)	

Most patients had comorbidities such as hypertension, which was found in 9 (45%) cases compared to 4 (10%) cases in the control group ($\chi^2 = 7.9$, $P = 0.006$, $OR = 4.6$). The combination of hypertension with atherosclerosis was detected in 2 (10%) patients of the main group compared to 34 (83%) patients in the control group ($\chi^2 = 26.6$, $P = 0.0005$, $OR = 8.2$). In the main group, the combination of hypertension with diabetes mellitus was not observed, while it was noted in 3 (7%) patients of the control group. In 9 (45%) patients of the main group ($\chi^2 = 18.0$, $P = 0.0005$), the disease was asymptomatic.

Analysis of neurological symptoms revealed that headaches, dizziness, decreased visual acuity, memory impairment, tinnitus and head noise, numbness in the limbs, motor and speech disorders, and other signs were the main clinical manifestations in patients with CCVI (Figure 2). Patients who had experienced transient disorders of cerebral circulation often complained of headache, dizziness, and tinnitus.

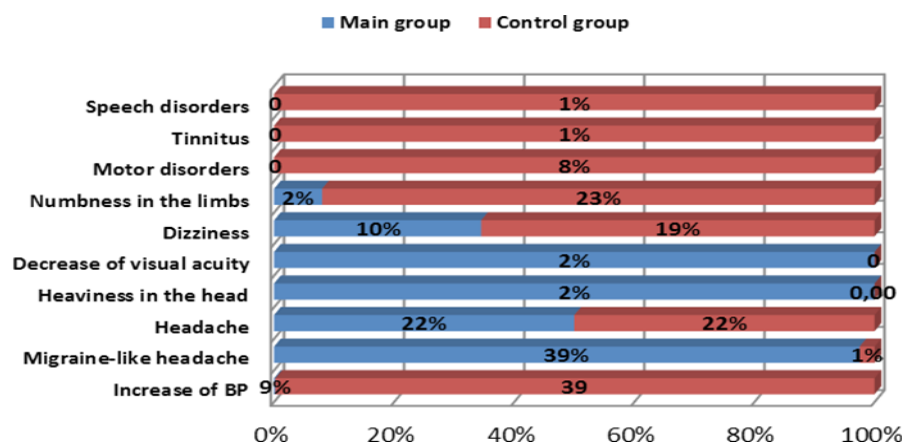


Figure 2. Age features of clinical manifestations in patients with CCVI

According to the classification of A. V. Pokrovsky (1979), 9 (45%) cases ($\chi^2 = 18.2$, $P = 0.0005$) developed an asymptomatic course (stage I of CCVI), and only in patients of the main group. The control group had a higher prevalence of stage III of CCVI in 20 (49%) patients ($\chi^2 = 2.6$, $P = 0.1$, $OR = 2.6$) and stage IV of CCVI in 19 (46%) patients ($\chi^2 = 16.6$, $P = 0.0006$). In the main group, stage III of CCVI was noted significantly less in 8 (40%) patients, and stage IV was not observed. Of the total 61 patients, 52 (85%) showed signs of cerebrovascular insufficiency of varying severity. 5 (8%) patients developed TIA, 28 (46%) patients had discirculatory encephalopathy, and 19 (31%) patients developed ischemic stroke.

It is noteworthy that among the 17 (89%) patients who suffered from ischemic stroke ($\chi^2 = 28.0$, $P = 0.0005$), there was combined pathology of PD with different degrees of ICA stenosis. A surgical method of treatment was used in 63% of patients, while a conservative method was applied in the remaining 37% of patients. Indications for surgical treatment included the presence of neurological deficit: previous strokes, TIA, hemodynamically significant PD determined by duplex study, PD of ICA + all types of plaques, narrowing the vascular lumen by more than 60%, PD of ICA + embologenic plaque. Duplex scanning of the brachiocephalic arteries (BCA) was performed in 50 (82%) patients.

Table 2. – The distribution of patients with CCVI by varieties of angiodysplasia of the cerebral arteries (according to the findings of duplex scanning of the brachiocephalic arteries)

Types of crimps	Main group N = 14	Control group N = 36
C- and S-shaped crimps	2(14%)	8(22%)
Bends at an acute angle	6(43%)	15(42%)
Loop formation	—	1(3%)
Different variants of crimps	1(7%)	1(3%)
Stenosis, occlusion of extracranial arteries	1(7%)	9(25%)
Norm	4(29%)	2(5%)
Total	14(100%)	36(100%)

Among the occurring types of angiodyplasias of ICA, bends at an acute angle were more frequently observed in the control group in 15 (42%) cases (kinking) compared to 6 (43%) cases in the main group (Table 2.). S- and C-shaped crimps were noted less frequently, and their incidence was also higher in the control group in 8 (22%) of 36 patients compared to 2 (14%) cases in the main group. The linear blood flow velocity of ICA averaged in the main group was 126.6 ± 12.8 cm/sec in the right, 101.5 ± 7.6 cm/sec in the left, whereas in patients of the control group, it averaged 122.6 ± 5.1 cm/sec in the right, 127.2 ± 8.2 cm/sec in the left. This was also an indication for surgical treatment.

Clinical manifestations and the development of chronic cerebrovascular insufficiency (CCVI) vary across different age groups. Some studies have reported a higher incidence of stable hypertension in patients under the age of 55, while hypertension combined with atherosclerosis is more commonly observed in the elderly [1]. Our data is consistent with these findings, as hypertension was more prevalent in younger patients, while atherosclerosis and hypertension were more common in middle-aged and elderly patients with varying degrees of CCVI. Hypertension alone increased the risk of CCVI by 4.6 times, while its combination with atherosclerosis raised the risk to 8.2 times.

According to L. Manvelov (2014), hypertension increases the risk of stroke by 3-4 times. V.V. Kakharchuk (2005) reported that hypertension combined with atherosclerosis increases the mortality rate from cardiovascular diseases by threefold. Isolated or combined pathologies of the internal carotid artery (ICA) and vertebral arteries have been reported, with 30% of ICA pathology patients presenting with abnormalities in the vertebral artery [2]. In our study, this combination was observed in 20% of the main group and 34% of the control group. A. V. Pokrovsky et al. (2011) reported that linear blood flow velocity in the deformation zone ranged from 60 to 350 cm/sec regardless of the form of PD (pathological deformation) of the ICA. Similarly, in our study, the linear blood flow velocity ranged from 60 to 320 cm/sec in the main group and 56 to 291 cm/sec in the control group. Although there were differences in age between the groups, the linear blood flow velocity in the area of PD of ICA did not vary significantly. This may be attributed to the presence of PD in the form of an inflection at an acute angle in young patients. Additionally, the combination of PD with hypo- or aplasias of the intracranial arteries increased the risk of CCVI development by 8.2 times, likely leading to a decrease in cerebral blood flow and subsequent cerebrovascular insufficiency.

4. Conclusion of Clinical and Diagnostic Manifestations of Chronic Cerebrovascular Insufficiency: Age-Related Differences and Angiodysplasias in Arterial Pathology

In conclusion, clinical and diagnostic manifestations of CCVI, such as migraine-like headaches, were more common in young patients, particularly males. Motor disorders, limb numbness, and dizziness, along with headaches, were more typical in middle-aged and elderly patients. Diagnostic tests revealed angiodyplasias in the form of hypo- or aplasias without PD in ICA in young patients, which were often asymptomatic. In middle-aged and elderly patients with stages III and IV of CCVI, isolated PD of ICA was observed, and the risk of CCVI occurrence was increased by 8.2 times in patients with angiodyplasias of the intra- or extracranial arteries. In young patients, extracranial angiodyplasias were innate and often remained clinically silent for a long time. PDs develop throughout life in middle-aged and elderly patients on a background of hypertension, atherosclerosis, and other vascular diseases, and more commonly affect the ICA.

5. References

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