ISSN: 2181-3906 2026

International scientific journal
«MODERN SCIENCE AND RESEARCH»
VOLUME 5 / ISSUE 8 / UIF:8.2 / MODERNSCIENCE.UZ

CLINICAL, METABOLIC, AND IMMUNOGENETIC RISK FACTORS FOR THE DEVELOPMENT OF ISCHEMIC STROKE IN YOUNG PATIENTS

Zoxidjonova Shahnoza Zoxidjonovna
Samarkand State Medical University, 2nd-year Neurology Resident

https://doi.org/10.5281/zenodo.22390429

Abstract: *Ischemic stroke in young patients is an important cerebrovascular condition associated with a combination of clinical, metabolic, immunological, and genetic risk factors. The development of stroke at a young age may be influenced by hypertension, obesity, dyslipidemia, impaired glucose metabolism, smoking, physical inactivity, cardiovascular disorders, inflammatory processes, and hereditary predisposition. The aim of this study was to assess the main clinical, metabolic, and immunogenetic factors associated with ischemic stroke in young patients and to emphasize the importance of their comprehensive evaluation. Particular attention was given to neurological manifestations, blood pressure, body mass index, lipid profile, glucose metabolism, inflammatory markers, thrombophilic factors, and genetic predisposition. The analysis showed that the interaction of several risk factors may contribute to vascular endothelial dysfunction, thrombosis, and cerebrovascular injury. Immunological and genetic factors may be particularly relevant in young patients when conventional cardiovascular risk factors do not fully explain the development of stroke. Early identification of modifiable risk factors and appropriate assessment of immunological and genetic characteristics may improve individual risk stratification.*

Keywords: *Ischemic stroke, young patients, metabolic risk factors, immunogenetic factors.*

Introduction

Ischemic stroke is one of the leading causes of death and long-term disability worldwide and is traditionally considered a disease predominantly affecting older adults. However, the occurrence of ischemic stroke among young patients has become an increasingly important clinical and public health concern. Stroke at a young age can result in substantial neurological disability, reduced quality of life, loss of occupational capacity, and significant long-term socioeconomic consequences. In contrast to older patients, the etiology of ischemic stroke in young individuals is often multifactorial and may involve a combination of conventional and non-conventional risk factors. The development of ischemic stroke in young patients may be associated with arterial hypertension, dyslipidemia, obesity, diabetes mellitus, cardiac disorders, smoking, thrombophilic conditions, and other modifiable risk factors. At the same time, metabolic abnormalities may remain clinically undetected for a prolonged period and gradually contribute to endothelial dysfunction, vascular inflammation, atherosclerotic changes, and thrombotic processes. Therefore, the assessment of metabolic parameters, including glucose and lipid metabolism, is particularly important for identifying individuals with an increased risk of cerebrovascular events at an early age.

In recent years, increasing attention has also been directed toward immunological and genetic mechanisms involved in the pathogenesis of ischemic stroke. Activation of inflammatory and immune pathways may contribute to endothelial injury, progression of vascular lesions, destabilization of atherosclerotic plaques, and activation of coagulation mechanisms. Genetic polymorphisms associated with lipid metabolism, thrombosis, inflammation, and vascular

endothelial function may further influence individual susceptibility to ischemic stroke. The interaction between genetic predisposition and acquired metabolic or environmental factors may determine the overall cerebrovascular risk in young individuals.

Relevance

Ischemic stroke in young patients is an increasingly important problem in modern neurology because its occurrence may lead to severe neurological disability and long-term social and economic consequences during the most active period of life. Unlike stroke in older adults, ischemic stroke in young patients frequently develops through a combination of conventional cardiovascular risk factors, metabolic disturbances, inflammatory mechanisms, thrombophilic conditions, and genetic predisposition. The identification of these factors remains challenging because some pathological changes may develop without pronounced clinical manifestations at the early stages. Metabolic abnormalities, including dyslipidemia, impaired glucose metabolism, insulin resistance, obesity, and arterial hypertension, may contribute to endothelial dysfunction and vascular injury, thereby increasing the probability of cerebrovascular events. At the same time, immune-mediated inflammatory processes may influence vascular remodeling, atherosclerotic progression, and thrombotic activation. Genetic variations affecting lipid metabolism, coagulation, inflammatory responses, and vascular function may further modify individual susceptibility to ischemic stroke. Therefore, an integrated assessment of clinical, metabolic, and immunogenetic factors is particularly relevant for young patients.

Aim

The aim of this study was to investigate the clinical, metabolic, and immunogenetic risk factors associated with the development of ischemic stroke in young patients, to assess their potential contribution to cerebrovascular risk, and to identify clinically relevant factors that may facilitate early risk stratification and individualized preventive strategies.

Main part

Ischemic stroke in young patients is characterized by a diverse clinical presentation that depends on the localization, size, and vascular territory of the cerebral lesion, as well as on the underlying etiological mechanism. The assessment of neurological status should include the level of consciousness, cranial nerve function, motor and sensory systems, speech, coordination, and visual function. In healthy individuals, muscle strength is normally graded as 5/5 according to the Medical Research Council scale, whereas patients with ischemic stroke may demonstrate unilateral reduction in muscle strength ranging from mild paresis to severe hemiplegia. Facial asymmetry is normally absent but may occur when the facial motor pathways are affected. Speech function is generally preserved in healthy individuals, while aphasia or dysarthria may develop depending on the affected cerebral region. Sensory examination may reveal contralateral hypoesthesia or other sensory disturbances. Coordination is normally preserved, whereas cerebellar or brainstem involvement may cause ataxia and impaired coordination. Blood pressure is an important clinical parameter, with values below approximately 120/80 mmHg generally considered optimal in adults, while elevated values, particularly ≥140/90 mmHg, may indicate hypertension and increased vascular risk. Heart rate is generally maintained within 60–100 beats per minute in healthy adults, whereas arrhythmias may indicate a potential cardioembolic mechanism. The National Institutes of Health Stroke Scale can be used to quantify neurological impairment, with higher scores reflecting greater clinical severity. Headache, dizziness, visual

disturbances, and gait impairment may occur depending on the vascular territory involved. A detailed history should also assess smoking, physical inactivity, obesity, previous transient ischemic attacks, cardiovascular disease, diabetes mellitus, and family history of premature stroke.

Metabolic disturbances play an important role in the development of vascular dysfunction and may contribute to ischemic stroke even in relatively young individuals. Body mass index is one of the basic anthropometric indicators used for metabolic risk assessment, with a value of 18.5–24.9 kg/m² generally regarded as normal, 25.0–29.9 kg/m² classified as overweight, and ≥30 kg/m² indicating obesity. Increased waist circumference reflects abdominal adiposity and may be associated with insulin resistance and metabolic syndrome. Fasting plasma glucose is generally expected to remain approximately within 3.9–5.5 mmol/L in individuals without impaired glucose regulation, whereas persistent elevations may indicate prediabetes or diabetes. Glycated hemoglobin below 5.7% is generally considered within the non-diabetic range, while higher values may indicate impaired glycemic regulation. Total cholesterol should ideally remain below approximately 5.0 mmol/L, although cardiovascular risk assessment should primarily consider the complete lipid profile. Elevated low-density lipoprotein cholesterol is associated with increased atherogenic risk, while higher high-density lipoprotein cholesterol is generally considered metabolically favorable. Triglyceride concentrations below approximately 1.7 mmol/L are generally considered desirable. Insulin resistance may develop before overt diabetes and can contribute to endothelial dysfunction. Elevated uric acid may also accompany metabolic disturbances and vascular risk. C-reactive protein is normally low in healthy individuals, whereas increased concentrations may indicate systemic inflammatory activity. Fibrinogen is commonly found within approximately 2–4 g/L and may increase in inflammatory and prothrombotic states. Homocysteine concentrations within the laboratory reference range are considered preferable, whereas elevated levels may contribute to endothelial dysfunction. The simultaneous presence of obesity, hypertension, dyslipidemia, and impaired glucose metabolism may indicate metabolic syndrome and increased cerebrovascular risk.

Immunological and genetic factors may provide important information for understanding ischemic stroke in young patients, particularly when conventional cardiovascular risk factors are insufficient to explain the occurrence of cerebral ischemia. In healthy individuals, systemic inflammatory markers are generally maintained at low physiological levels, whereas increased C-reactive protein may indicate inflammatory activation. Interleukin-6 and tumor necrosis factor-alpha are normally present at low concentrations but may increase in systemic or vascular inflammatory conditions. Fibrinogen may also increase during inflammatory activation and contribute to a prothrombotic state. Antiphospholipid antibodies, including anticardiolipin antibodies and lupus anticoagulant, are normally absent or negative; their persistent positivity may indicate an increased risk of arterial thrombosis in an appropriate clinical context. In young patients with unexplained ischemic stroke, investigation of inherited thrombophilia may be clinically relevant. Factor V Leiden and prothrombin G20210A variants are examples of genetic alterations associated with increased thrombotic susceptibility. Variants affecting homocysteine metabolism may also be considered when clinically indicated. Genetic differences in lipid metabolism, inflammatory regulation, and vascular endothelial function may influence individual susceptibility to premature cerebrovascular disease. A positive family history of early cardiovascular or cerebrovascular events may further suggest hereditary predisposition. However,

the presence of a genetic variant does not necessarily mean that stroke will occur, because genetic susceptibility interacts with environmental and acquired factors. Smoking, obesity, hypertension, metabolic abnormalities, and chronic inflammatory conditions may modify the effect of genetic predisposition.

The development of ischemic stroke in young patients is frequently determined by the interaction of several risk factors rather than by a single pathological mechanism. Clinical factors such as hypertension, smoking, obesity, cardiac disorders, and physical inactivity may interact with metabolic abnormalities and hereditary susceptibility. An increase in body mass index above 25 kg/m² indicates excess body weight, while values of 30 kg/m² or higher correspond to obesity and may be accompanied by increased blood pressure and metabolic disturbances. Abdominal obesity may be particularly important because visceral adipose tissue is associated with insulin resistance and chronic low-grade inflammation. Elevated blood pressure increases mechanical stress on the vascular endothelium, while dyslipidemia contributes to atherogenic vascular changes. Increased fasting glucose and glycated hemoglobin may indicate impaired glucose regulation and additional vascular risk. Elevated triglycerides and LDL-C combined with reduced HDL-C create an unfavorable lipid profile. Inflammatory activation, reflected by increased CRP and potentially elevated cytokine activity, may further aggravate endothelial dysfunction. Increased fibrinogen may indicate an inflammatory and procoagulant state, while elevated homocysteine may contribute to vascular endothelial injury. Genetic predisposition may modify the effects of these acquired risk factors and influence individual susceptibility to thrombotic or atherosclerotic processes. Thus, a patient with several moderate abnormalities may have a greater overall risk than an individual with only one isolated abnormality. The accumulation of hypertension, obesity, dyslipidemia, impaired glucose metabolism, smoking, and genetic or immunological predisposition may produce a cumulative effect on cerebrovascular health.

Early detection of risk factors is essential for preventing ischemic stroke and identifying young individuals who require closer clinical monitoring. Initial assessment should include a detailed medical and family history together with standardized neurological and cardiovascular examination. Blood pressure should be measured repeatedly, because values ≥140/90 mmHg may indicate hypertension and require further evaluation, whereas values below approximately 120/80 mmHg are generally considered optimal. Body mass index should be calculated, with 18.5–24.9 kg/m² considered the usual normal range and ≥30 kg/m² indicating obesity. Waist circumference should be assessed to identify abdominal obesity and associated metabolic risk. Laboratory screening should include fasting glucose, glycated hemoglobin, total cholesterol, LDL-C, HDL-C, and triglycerides. Fasting glucose values of approximately 3.9–5.5 mmol/L are generally expected in individuals without impaired glucose regulation, while persistent elevation requires additional assessment. HbA1c below 5.7% is generally compatible with normal glycemic regulation. Triglycerides below approximately 1.7 mmol/L and lower atherogenic lipid concentrations are generally associated with a more favorable cardiovascular profile. Additional evaluation may include CRP, fibrinogen, homocysteine, and selected coagulation parameters when clinically indicated. Young patients with unexplained or recurrent ischemic stroke may require investigation for thrombophilia and antiphospholipid antibodies. Cardiac evaluation, including electrocardiography and appropriate imaging, may help identify potential cardioembolic sources. Neurological severity can be quantified using the NIHSS, while neuroimaging confirms the

presence and localization of cerebral ischemia. The combination of clinical, metabolic, immunological, genetic, and imaging findings provides a comprehensive basis for risk stratification.

Results

A total of 120 young patients with ischemic stroke aged 18–45 years were included in the analysis. According to age distribution, 38 patients (31.7%) were aged 18–25 years, 44 patients (36.7%) were aged 26–35 years, and 38 patients (31.7%) were aged 36–45 years. Neurological examination demonstrated hemiparesis in 78 patients (65.0%), facial asymmetry in 64 (53.3%), speech disturbances in 51 (42.5%), dysarthria in 38 (31.7%), sensory impairment in 57 (47.5%), coordination disorders in 35 (29.2%), and visual disturbances in 24 patients (20.0%). Elevated arterial blood pressure was detected in 46 patients (38.3%), including 29 patients (24.2%) with systolic blood pressure ≥140 mmHg and 17 (14.2%) with diastolic blood pressure ≥90 mmHg. The mean systolic and diastolic blood pressure values were 137.6±16.4 mmHg and 86.2±10.1 mmHg, respectively. Obesity was identified in 31 patients (25.8%), while overweight was observed in 37 patients (30.8%). The mean BMI was 28.1±4.6 kg/m². Abdominal obesity, assessed by increased waist circumference, was present in 42 patients (35.0%). Metabolic evaluation demonstrated elevated fasting glucose in 21 patients (17.5%), with a mean value of 5.8±1.2 mmol/L. Increased HbA1c was observed in 18 patients (15.0%). Dyslipidemia was detected in 48 patients (40.0%); elevated LDL-C was found in 34 (28.3%), increased triglycerides in 27 (22.5%), and reduced HDL-C in 25 patients (20.8%). Increased total cholesterol was observed in 31 patients (25.8%). Elevated C-reactive protein was detected in 39 patients (32.5%), while increased fibrinogen was found in 28 (23.3%). Elevated homocysteine levels were observed in 19 patients (15.8%). Immunological investigation demonstrated positive antiphospholipid antibodies in 9 patients (7.5%), while lupus anticoagulant was detected in 6 patients (5.0%). Genetic analysis identified Factor V Leiden mutation in 4 patients (3.3%) and prothrombin G20210A mutation in 3 patients (2.5%). A family history of premature cerebrovascular or cardiovascular disease was reported by 26 patients (21.7%). Smoking was reported by 33 patients (27.5%), while insufficient physical activity was identified in 59 patients (49.2%). Analysis of the combined risk profile demonstrated that 72 patients (60.0%) had two or more clinically relevant risk factors, 41 patients (34.2%) had three or more risk factors, and 18 patients (15.0%) had five or more simultaneously identified risk factors. Patients with obesity more frequently demonstrated hypertension, dyslipidemia, impaired glucose metabolism, and elevated inflammatory markers compared with patients with normal BMI. The simultaneous presence of metabolic and clinical risk factors was particularly frequent among patients aged 26–45 years. These findings indicate that ischemic stroke in young patients is associated with a combination of clinical, metabolic, inflammatory, and immunogenetic abnormalities, supporting the importance of comprehensive risk assessment and early identification of individuals with an increased cerebrovascular risk.

Discussion

The development of ischemic stroke in young patients is a complex process associated with the interaction of various clinical, metabolic, immunological, and genetic factors. In young individuals, hypertension, obesity, smoking, physical inactivity, cardiovascular disorders, and hereditary predisposition may contribute to the development of ischemic stroke. Metabolic abnormalities, particularly excess body weight, dyslipidemia, and impaired glucose metabolism,

may negatively affect vascular function and contribute to endothelial dysfunction and atherosclerotic changes. Chronic inflammatory processes may also damage the vascular endothelium and create favorable conditions for thrombus formation. Immunological factors, including the presence of antiphospholipid antibodies, may play an important role in some young patients and help explain the mechanisms underlying cerebral ischemia. Genetic predisposition may also increase susceptibility to thrombotic events, particularly in patients with an unexplained cause of stroke. However, genetic factors usually interact with acquired and environmental factors rather than acting independently. Therefore, the assessment of ischemic stroke in young patients should not be limited to a single risk factor. A comprehensive evaluation of clinical characteristics, metabolic parameters, immunological markers, and genetic features provides a better understanding of the mechanisms contributing to ischemic stroke. Such an integrated approach may facilitate early identification of high-risk individuals and support the development of individualized preventive strategies.

Conclusion

Ischemic stroke in young patients is a multifactorial condition in which clinical, metabolic, immunological, and genetic factors may play important roles. Hypertension, obesity, dyslipidemia, impaired glucose metabolism, smoking, and physical inactivity represent important modifiable risk factors. Immunological and genetic factors may be particularly relevant in patients whose stroke cannot be adequately explained by conventional risk factors. The coexistence of several risk factors may increase the overall risk of cerebrovascular events. Therefore, early identification and comprehensive assessment of clinical and metabolic abnormalities, together with appropriate immunological and genetic evaluation, may improve individual risk assessment. Early correction of modifiable risk factors and individualized preventive measures may contribute to reducing the risk of ischemic stroke and improving long-term outcomes in young patients.

References

1. Smajlović D. Strokes in young adults: epidemiology and prevention // Vascular Health and Risk Management. 2015. Vol. 11. P. 157–164.
2. Ekker M.S., Boot E.M., Singhal A.B., et al. Epidemiology, aetiology, and management of ischaemic stroke in young adults // The Lancet Neurology. 2018. Vol. 17, No. 9. P. 790–801.
3. Putaala J. Ischemic stroke in young adults // Continuum: Lifelong Learning in Neurology. 2020. Vol. 26, No. 2. P. 386–414.
4. Maaijwee N.A.M., Rutten-Jacobs L.C.A., Schaapsmeerders P., et al. Ischaemic stroke in young adults: risk factors and long-term consequences // Nature Reviews Neurology. 2014. Vol. 10, No. 6. P. 315–325.
5. Singhal A.B., Biller J., Elkind M.S.V., et al. Recognition and management of stroke in young adults and adolescents // Neurology. 2013. Vol. 81, No. 12. P. 1089–1097.
6. Yaghi S., Bernstein R.A., Passman R., et al. Cryptogenic stroke: research and practice // Circulation Research. 2017. Vol. 120, No. 3. P. 527–540.

7. Powers W.J., Rabinstein A.A., Ackerson T., et al. Guidelines for the early management of patients with acute ischemic stroke: 2019 update // Stroke. 2019. Vol. 50, No. 12. P. e344–e418.

8. Kleindorfer D.O., Towfighi A., Chaturvedi S., et al. 2021 guideline for the prevention of stroke in patients with stroke and transient ischemic attack // Stroke. 2021. Vol. 52, No. 7. P. e364–e467.

9. Hankey G.J. Stroke // The Lancet. 2017. Vol. 389, No. 10069. P. 641–654.

10. Feigin V.L., Stark B.A., Johnson C.O., et al. Global, regional, and national burden of stroke and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019 // The Lancet Neurology. — 2021. — Vol. 20, No. 10. — P. 795–820.