# RISK FACTORS FOR PERIOPERATIVE STROKE DEVELOPMENT IN CARDIAC SURGERY

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**Abstract** Risk factors for perioperative stroke development are diverse and can be divided into patient-related factors and factors directly related to surgical intervention. This review discusses risk factors, potential mechanisms, prevention strategies, and the impact of stroke on clinical outcomes in the postoperative period.

**Keywords:** stroke, cardiac surgery, pathogenesis, cardiovascular complications.

## ФАКТОРЫ РИСКА РАЗВИТИЯ ПЕРИОПЕРАЦИОННОГО ИНСУЛЬТА ПРИ КАРДИОХИРУРГИЧЕСКИХ ВМЕШАТЕЛЬСТВАХ

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**Аннотация** Факторы риска развития периоперационного инсульта многообразны, и они условно могут быть разделены на факторы, связанные с пациентом, и факторы, связанные непосредственно с оперативным вмешательством. Данный обзор посвящен обсуждению факторов риска, потенциальных механизмов, стратегий профилактики, а также влиянию инсульта на клинические исходы в послеоперационном периоде.

**Ключевые слова**: инсульт, кардиохирургия, патогенез, сердечно-сосудистые осложнения.

## YURAK JARROHLIGIDA PERIOPERATIV INSULT RIVOJLANISHI XAVF FAKTORLARI

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**Annotatsiya** Perioperativ insult rivojlanishi uchun xavf omillari xilma-xil bo'lib, ularni bemor bilan bog'liq omillarga va jarrohlik aralashuvga bevosita bog'liq bo'lgan omillarga bo'lish mumkin. Ushbu sharhda xavf omillari, potentsial mexanizmlar, oldini olish strategiyalari va operatsiyadan keyingi davrda insultning klinik natijalarga ta'siri muhokama qilinadi.

**Kalit so'zlar:** insult, kardiojarrohlik, patogenez, yurak-qon tomir asoratlari.

## Relevance of the research

Perioperative stroke is the most severe complication of surgical interventions. The risk of developing this complication depends on the type of intervention. If in non-cardiac surgical interventions it is 0.1–2.0%, then in high-risk cardiac surgery it can reach 10% [1]. Perioperative stroke leads to an increase in mortality and disability of patients, and also contributes to the overexpenditure of financial and human resources. Clinically hidden (asymptomatic) strokes also contribute to the deterioration of neurocognitive dysfunction in the long term, as well as the development of clinically significant strokes [2].

A consensus document of the Society for the Neurosciences of Anesthesiology and Critical Care defines perioperative stroke as a cerebral infarction of ischemic or hemorrhagic etiology that occurs during surgery or 30 days after surgery, including the development of stroke after awakening from anesthesia. Perioperative Stroke Rate and Its Impact on Clinical Outcomes Despite advances in medical technology and drug development, perioperative neurological complications remain a major cause of increased hospital stay, disability, and mortality. A minority of all perioperative strokes occur intraoperatively; 30% occur within the first 2 days; approximately 50% occur by the 5th postoperative day; and 20–25% develop during hospitalization [3].

According to the American College of Surgeons database, the stroke rate in patients undergoing low-risk surgery is 0.14% [4]. In the prospective VISION study, which included 40,004 patients over 45 years of age undergoing non-cardiac surgery (28 centers from 14 countries), the stroke rate was 0.3% [5]. This study showed that ischemic stroke was much more common than hemorrhagic stroke. The prospective cohort multicenter NeuroVISION study included 1114 patients over 65 years of age who underwent elective non-cardiac surgery [6]. All patients underwent MRI in the immediate postoperative period to assess latent (clinically "silent") stroke. In addition, all patients underwent neurocognitive status and delirium assessment. It was shown that the incidence of latent stroke was 7% (78 patients). Moreover, the development of this complication was accompanied by an increased risk of postoperative delirium (by 2.2 times) and deterioration of neurocognitive function 1 year after surgery (by 2 times). The risk of transient ischemic attack within 1 year after surgery in patients with latent stroke increased 4-fold. Cardiac surgery patients are at high risk for perioperative stroke due to underlying comorbidities and invasive technologies used to provide surgeries. The incidence of clinically significant stroke in cardiac surgery ranges from 1 to 6% [7].

According to a meta-analysis of 42 studies (2632 patients), the incidence of occult stroke in patients undergoing CABG is 25% [8]. In a small prospective study, A.

Browne et al. (2020) showed that occult stroke developed in 39% of patients after CABG surgery. Despite the apparent harmlessness of occult stroke, the risk of developing dementia, cognitive impairment, and clinically significant strokes in the future increases. Stroke risk factors can be divided into modifiable, conditionally modifiable, and non-modifiable. Patient age (especially over 65 years) is one of the most important risk factors for stroke in the postoperative period, with the risk increasing with each additional year of life. The presence of concomitant pathology in the patient, such as chronic kidney disease, arterial hypertension, diabetes mellitus, ischemic heart disease, stroke in history, as well as smoking increase the risk of stroke [9].

Today, the development of predictive models for the development of perioperative cardiovascular complications, including stroke, is of particular relevance. Identification of patients at high risk for the development of this complication can potentially improve outcomes by changing the tactics of patient management. In addition, the detection of new markers of brain damage in the blood, such as the light chain of neurofilament in the blood, can be a useful method for screening for ischemic neuronal damage [10].

Postoperative atrial fibrillation (AF) is one of the most common cardiovascular complications after non-cardiac surgery, and the frequency of AF depends on the extent of the surgical intervention. In turn, AF increases the risk of stroke in the postoperative period by 2-4 times; the risk of stroke also increases in the late periods after surgery. The presence of an open oval window in a patient increases the risk of paradoxical embolism when changing the bypass from the right to the left sides of the heart. A systematic review of non-cardiac surgery patients showed that the risk of stroke increases by 4 times [11].

However, the most common and most recognized factor in the development of perioperative stroke is hypotension. Analysis of the POISE-I study results showed that clinically significant hypotension was the most significant predictor of postoperative stroke [12]. One of the largest retrospective studies, which included 358,391 patients, demonstrated that intraoperative hypotension (a decrease in SBP <55 mmHg or a decrease in SBP by 30% compared with baseline values) is a predictor of stroke within 7 days after surgery. SBP less than 55 mmHg was also associated with the development of postoperative delirium [13].

Perioperative bleeding can also lead to hemodynamic disturbances and deterioration of the oxygen transport function of the circulatory system. An analysis of 651,775 non-cardiac surgery patients showed that in patients with significant bleeding (bleeding requiring transfusion of more than 4 units (about 1 liter) of packed red blood cells) the risk of stroke increases by 2.7 times within 30 days after surgery. In addition, the development of bleeding also leads to a delay in the resumption of antithrombotic

therapy in the postoperative period, which also increases the risk of stroke [14].

The main intraoperative causes of stroke during cardiac surgery include thromboembolism, cerebral hypoperfusion (low mean arterial pressure, carotid artery stenosis, cerebral atherosclerosis) and systemic inflammatory response syndrome when blood comes into contact with the foreign surface of the artificial blood circulation circuits. In the early postoperative period, risk factors for stroke include AF, low cardiac output syndrome and bleeding. The source of thromboembolism can be an atherosclerotic aorta, heart and artificial blood circulation circuits. Manipulations on the aorta are associated with its cannulation, clamping of the aorta, as well as with the imposition of distal anastomoses during CABG surgery. Atherosclerosis of the ascending aorta occurs in more than 50% of patients with coronary heart disease [15].

Doppler analysis of microembolic signals showed their maximum frequency at the beginning of artificial circulation, as well as during application and removal of the clamp from the aorta.

Most strokes in cardiac surgery during the first week are associated with hemodynamic instability and cardiac arrhythmias. Newly occurring AF in the postoperative period is a risk factor for recurrent AF in the late postoperative periods, and, consequently, stroke. Formation of blood clots in the left atrium in the absence of adequate anticoagulant therapy is also one of the factors contributing to the development of stroke.

**List of references:**

1. Коломенцев С. В., Янишевский С. Н., Вознюк И. А. и др. Профилактика периоперационного ишемического инсульта после некардиохирургических и ненейрохирургических операций в свете Научного заявления и Рекомендаций по вторичной профилактике ишемического инсульта и транзиторной ишемической атаки AHA/ASA 2021 г. Часть 1: Определение, факторы риска, патогенез, прогнозирование, принципы пред- и интраоперационной профилактики // Acta Biomedica Scientifica. – 2023. –Т. 8, No 2. – С. 103–116.

2. Salazar J. D., Wityk R. J., Grega M. A. et al. Stroke after cardiac surgery: short- and long-term outcomes // Ann Thorac Surg. – 2001. – Vol. 72, No 4. –P. 1195–1201.

3. Marcucci M., Chan M.T.V., Smith E.E. et al. Prevention of perioperative stroke in patients undergoing non-cardiac surgery. Lancet Neurol, 2023, vol. 22, no. 10, pp. 946–958.

4. Mashour G. A., Shanks A. M., Kheterpal S. Perioperative stroke and associated mortality after noncardiac, nonneurologic surgery // Anesthesiology. –2011. – Vol. 114, No 6. – P. 1289–1296.

5. Spence J., LeManach Y., Chan M.T.V. Association between complications and death within 30 days after noncardiac surgery. CMAJ, 2019, vol. 191, no. 30, pp. E830–E837.

6. NeuroVISION investigators. Perioperative covert stroke in patients undergoing non-cardiac surgery (NeuroVISION): A prospective cohort study // Lancet. –2019. – Vol. 394, No 10203. – P. 1022–1029.

7. Floyd T. F., Shah P. N., Price C. C. et al. Clinically silent cerebral ischemic events after cardiac surgery: their incidence, regional vascular occurrence, and procedural dependence // Ann Thorac Surg. – 2006. – Vol. 81, No6.–P. 2160–2166.

8. Indja B., Woldendorp K., Vallely M. P. et al. Silent brain infarcts following cardiac procedures: a systematic review and meta-analysis // J Am Heart Assoc. – 2019. – Vol. 8, No 9. – P. e010920.

9. Browne A., Spence J., Power P. et al. Perioperative covert stroke in patients undergoing coronary artery bypass graft surgery // JTCVS Open. – 2020.–Vol. 4. – P. 1–11.

10. Taylor J., Eisenmenger L., Lindroth H. et al. Perioperative ischaemic brain injury and plasma neurofilament light: a secondary analysis of two prospective cohort studies // Br J Anaesth. – 2023. – Vol. 130, No 2. – P. 361–369.

11. Hobbes B., Akseer S., Pikula A. et al. Risk of perioperative stroke in patients with patent foramen ovale: a systematic review and metaanalysis // Can J Cardiol. – 2022. – Vol. 38, No 8. – P. 1189–1200.

12. Devereaux P. J., Yang H., Yusuf S. et al. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial // Lancet. – 2008. – Vol. 371, No 9627. – P. 1839–1847.

13. Wachtendorf L. J., Azimaraghi O., Santer P. et al. Association Between Intraoperative Arterial Hypotension and Postoperative Delirium After Noncardiac Surgery: A Retrospective Multicenter Cohort Study // Anesth Analg. – 2022. –Vol. 134, No 4. – P. 822–833.

14. Marcucci M., Chan M. T. V., Smith E. E. et al. Prevention of perioperative stroke in patients undergoing non-cardiac surgery // Lancet Neurol. – 2023. –Vol. 22, No 10. – P. 946–958.

15. Head S. J., Boergermann J., Osnabrugge R. L. J. et al. Coronary artery bypass grafting: part 2— optimizing outcomes and future prospects // Eur Heart J. –2013. – Vol. 34, No 37. – P. 2873–2886.