Case Report

https://doi.org/10.23934/2223-9022-2023-12-2-309-315

Emergency Stenting of Tandem Stenoses of the Internal Carotid Artery Using Proximal Protection Against Distal Embolism "MoMa"

E.Yu. Kachesov[1], A.N. Kazantsev[2] ✉, A.V. Bykovsky[1], A.V. Korotkykh[3]

Department of Vascular Surgery
[1] City Aleksandrovsky Hospital
4, Solidarnosti Prosp., 193312, St. Petersburg, Russian Federation
[2] Y.I. Korolyova Kostroma Regional Clinical Hospital
114, Mira Prosp., 156013, Kostroma, Russian Federation
[3] Amur State Medical Academy
95, Gorky Str., 675000, Blagoveshchensk, Russian Federation

✉ **Contacts:** Anton N. Kazantsev, Chief Cardiovascular Surgeon of the Kostroma Region, Head of the Department of Vascular Surgery, Kostroma Regional Clinical Hospital.
Email: dr.antonio.kazantsev@mail.ru

ABSTRACT Man, 61 years old. Admitted with complaints of severe weakness in the right limbs, which developed about 4 hours ago. Multispiral computed tomography with cerebral angiography: signs of ischemic stroke in the basin of the left middle cerebral artery. Angiography of the brachiocephalic arteries (BCA) was performed: angiographic signs of damage to the BCA: the left internal carotid artery (ICA) of the C2–C3 segments up to subocclusion, up to 75% in the mouth and right third. The circle of Willis is closed.

A multidisciplinary council made a decision on emergency stenting of tandem ICA stenoses using proximal protection against distal embolism "MoMa". The course of the operation: after angiography, the sheath introducer was replaced by a guidewire sheath with a 9F introducer. A proximal protection system "MoMa" was installed along the diagnostic conductor 260 cm at the mouth of the left external carotid artery (ECA) and the middle third of the left common carotid artery (OCA). Baloons in the ECA and OCA were inflated. The Promus element 4.0x12 mm (DES) ICA was brought into the affected area of C2–C3 segments, positioned and opened at a pressure of up to 14 atm. The balloon catheter has been removed. Aspiration from the ICA. On check angiography, residual stenosis of the ICA stenting zone was 0%. On the test angiography intracranial arteries without signs of embolism. A Protege (7x10x40) mm stent was placed, positioned and deployed in the affected area of the orifice and the right third of the ICA. The delivery system has been removed. Aspiration from the ICA. On the test angiography, the residual stenosis of the ICA stenting zone was up to 0%. The distal embolism protection system has been removed. On the control angiography intracranial arteries without signs of embolism.

The postoperative period was uneventful. On the 10th day after stenting, the neurological deficit regressed completely, the patient was discharged for outpatient observation in a satisfactory condition.

CONCLUSIONS When performing brain revascularization in the most acute period of ischemic stroke, it is necessary to take into account the recommendations of multicenter studies that report such conditions for a successful outcome of the operation as: the diameter of the ischemic focus in the brain, not exceeding 2.5 cm and the absence of severe neurological deficit (more than the Rankin scale score 2). Within the framework of this clinical example, these recommendations were taken into account, which, among other things, contributed to the optimal outcome of urgent revascularization. Emergency stenting of tandem stenosis of the internal carotid artery using the device for proximal protection "MoMa" is effective in the presence of a closed structure of the circle of Willis. The technical complexity of the operation is associated with the installation of a catheter guide and its diameter of 9 Fr (catheters up to 7 Fr are usually used), which requires additional manual skills.

Keywords: acute period, emergency stenting, stenting of the internal carotid artery, MoMa protection device, proximal protection, carotid angioplasty with stenting, carotid endarterectomy

For citation Kachesov EYu, Kazantsev AN, Bykovsky AV, Korotkykh AV. Emergency Stenting of Tandem Stenoses of the Internal Carotid Artery Using Proximal Protection Against Distal Embolism "MoMa". *Russian Sklifosovsky Journal of Emergency Medical Care*. 2023;12(2):309–315. https://doi.org/10.23934/2223-9022-2023-12-2-309-315 (in Russ.)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments, sponsorship The study had no sponsorship

Affiliations

Eduard Yu. Kachesov	Head of the Department of X-ray Endovascular Surgery, St. Petersburg City Aleksandrovsky Hospital; http://orcid.org/0000-0001-7141-9800, aaapppmmmooo@rambler.ru; 61%, writing an article, stylistic editing, performing an operation
Anton N. Kazantsev	Chief Cardiovascular Surgeon of the Kostroma Region, Head of the Department of Vascular Surgery, Kostroma Regional Clinical Hospital; https://orcid.org/0000-0002-1115-609X, dr.antonio.kazantsev@mail.ru; 20%, article writing

Andrey V. Bykovsky	Candidate of Medical Sciences, X-ray Endovascular Surgeon, Department of X-ray Endovascular Surgery, St. Petersburg City Aleksandrovsky Hospital; https://orcid.org/0000-0003-1131-9503, bomjiha@mail.ru; 10%, illustration preparation, operation assistance
Aleksandr V. Korotkikh	Chief Physician, Clinic of Cardiac Surgery, Amur State Medical Academy; https://orcid.org/0000-0002-9709-1097, ssemioo@rambler.ru; 9%, concept and design of the article, preparation of a literature review

BCA – brachiocephalic arteries
ICA – internal carotid artery
CAS – carotid angioplasty with stenting
CEE – carotid endarterectomy
ECA – external carotid artery
CCA – common carotid artery

INTRODUCTION

Issues of cerebral revascularization in the acute period of ischemic stroke have always been characterized by high relevance and significance [1–5]. There is no doubt that carotid endarterectomy (CEE) is the "gold standard" for the treatment of patients with hemodynamically significant stenoses of the internal carotid arteries (ICA) [6–10]. Carotid angioplasty with stenting (CAS) is an alternative option for open surgery [11–13]. But which of the two types of reconstruction is more preferable in the urgent mode, the current recommendations do not give a final answer [14]. However, recent Russian multicenter studies have shown that the results of emergency CEA, in contrast to CAS, are characterized by a high risk of adverse cardiovascular events, including hemorrhagic transformation [15–17]. The manifestation of the latter is most often associated with subsequent cerebral edema and death [15–18]. Its development is associated with the effect of the reperfusion syndrome, which is especially acute after clamping the ICA and starting blood flow into the ischemic area during CEA [15–19]. CAS, on the other hand, makes it possible to avoid such manipulations due to the use of modern embolism protection systems [15, 17]. However, when analyzing the world literature, it should be noted that there is a lack of reports on the outcomes of CAS of tandem ICA stenoses in the most acute period of ischemic stroke. There are also no studies on the efficacy and safety of emergency CAS when it is impossible to install a distal embolism protection device [20-24].

The aim of this publication was to demonstrate the clinical observation of CAS of tandem ICA stenosis using "*MoMa*" proximal protection against distal embolism in the most acute period of ischemic stroke.

Clinical example

Patient L., 61 years old. He was admitted with complaints of severe weakness in the right limbs, which developed about 4 hours before seeking medical help.

Examination. General condition of moderate severity. Conscious. Skin of natural color and moisture. Hemodynamics is stable. Blood pressure 143/86 mm Hg, pulse is 84 beats per minute, rhythmic. Breathing: independent. Respiratory rate 16 per minute, oxygen saturation 99%. Breathing is heard on the left and right evenly. No wheezing. Abdomen: painless, soft. Peristalsis is active. Diuresis is adequate. Body temperature 36.6°C.

Neurological status upon admission: fully conscious. Meningeal signs: negative. Cognitive functions and memory: normal. Speech: mild dysarthria. Violations of the visual fields: not detected. Eye slits: *D*=*S*. Pupils: *D*=*S*. Pupillary light reflexes positive (direct and simultaneous). The movement of the eyeballs: full. Diplopia: does not present. There is no hemianopia. The face is symmetrical. There are clearly no paresis. The strength in the upper limbs on the left is 4 points. The strength in the upper limbs on the right is 1 point. The strength in the lower limbs on the left was 5 points. The strength in the upper limbs on the right was 4 points. No sensory disturbances. In the Romberg pose, he sways. Meningeal signs: negative. The gait is hemiparetic. Intelligence reduced. Emotional sphere: calm.

Multispiral computed tomography with cerebral angiography: signs of ischemic stroke in the territory of the left middle cerebral artery (Fig. 1). Closed structure of the circle of Willis. Atherosclerosis of the vessels of the brain.

Fig. 1. Multislice computed tomography with cerebral angiography: signs of ischemic stroke in the basin of the left middle cerebral artery

Color duplex scanning of the brachiocephalic arteries (BCA): stenosis of the mouth of the left ICA 75%, right ICA 50%.

Echocardiography: ejection fraction 61%. Dilatation of the cavity of the left atrium. The myocardium of the left ventricle is symmetrically thickened. Compaction and fibrosis of the interventricular septum. Pericardium without features.

A multidisciplinary consultation (neurologist, cardiovascular surgeon, endovascular surgeon, neurosurgeon, cardiologist, anesthetist, resuscitator) decided to perform emergency angiography of the BCA followed by stenting of the left ICA.

Angiography of the BCA was performed: angiographic signs of damage to the BCA: left ICA C2–C3 up to subocclusion (Fig. 2), in the mouth and right third up to 75% (Fig. 3). The circle of Willis is closed.

Progress of the operation: the introducer over the guidewire was replaced with a 9*F introducer*. A proximal protection system "*MoMa* " was installed along the diagnostic conductor 260 cm at the mouth of the left external carotid artery (ECA) and the middle third of the left common carotid artery (CCA) (Fig. 4).

Balloons in the ECA and OCA are inflated. A *Promus Element* 4.0×12 mm stent (*DES*) was inserted into the affected area of the C2–C3 ICA segments, positioned and expanded at a pressure of up to 14 atm (Fig. 5).

Fig. 2. Angiography of the brachiocephalic arteries: 1 — stenosis of the left internal carotid artery C2–C3 to subocclusion

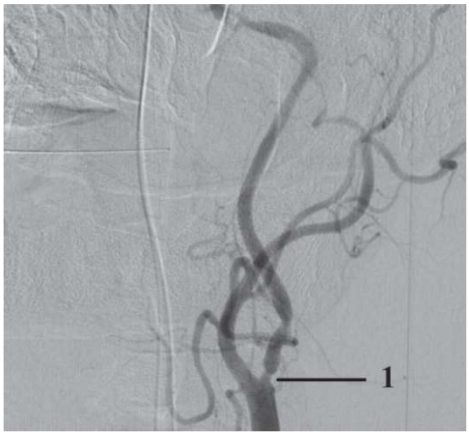

Fig. 3. Angiography of the brachiocephalic arteries: 1 - stenosis of the mouth of the left internal carotid artery 75%

Fig. 4. Insertion of MoMa into the external carotid artery (1)

Fig. 5. Stent implantation in C2–C3 segment of the internal carotid artery (1)

The balloon catheter was removed. Aspiration from the ICA. On test angiography, residual stenosis of the ICA stenting area was 0% and intracranial arteries without signs of embolism. A *Protege* stent —7×10×40 mm— was inserted, positioned, and expanded into the affected area of the ostium and the right third of the ICA (Fig. 6).

Fig. 6. Stent implantation at the orifice of the internal carotid artery (1)

The delivery system has been removed. Aspiration from the ICA. On the control angiography, the residual stenosis of the ICA stenting zone was up to 0%. The distal embolism protection system has been removed. On the control angiography intracranial arteries without signs of embolism. The device has been removed. Hemostasis of the puncture site of the right common femoral artery with the *Angio-Seal device*. Aseptic and pressure bandages.

The postoperative period was uneventful. On the 10th day after stenting, the neurological deficit regressed completely, the patient was discharged for outpatient observation in satisfactory condition.

DISCUSSION

Currently, performing CAS without the use of devices to prevent distal embolization is unacceptable [13, 20–23]. In this clinical example, the patient was diagnosed with subocclusion of the distal C2 segment and 75% stenosis of the left ICA ostium. The very presence of a subocclusive lesion is a relative contraindication for the use of a filtering device for the prevention of distal embolism due to the high risk of damage to the cap of the atherosclerotic plaque or dislocation of thrombotic masses during the passage of the instrument through the subocclusion segment [20–24]. In addition, the high location of the distal stenosis implies opening of the filter device only at the level of the ICA siphon, which, due to the diameter of about 3.5 mm and the tortuosity of this segment, can lead to incomplete closure of the arterial lumen by the filter element and accordingly increase the risk of distal embolism

[20–24]. Thus, in this observation it is more appropriate to use proximal protection. Proximal protection against distal embolism "*MoMa*" is a wide-bore 9Fr guide catheter with two independent latex balloons [20-24]. The distal one is smaller for implantation at the mouth of the ECA in order to block the collateral blood flow from the ECA to the ICA and the proximal one is to block the antegrade blood flow to the CCA. After both balloons are inflated, retrograde blood flow from the guide catheter is assessed and a clinical assessment of the degree of ischemia in the carotid territory is performed. Then, after balloon plasty and (or) stenting, aspiration from the guide catheter is performed with the removal of all possible thrombotic masses and plaque elements. The fundamental point of safe application of proximal protection against distal embolism is the presence of functioning communicating arteries (the closed structure of the circle of Willis), which will provide collateral blood flow in the target carotid basin [20–24]. In the presented clinical observation, the anterior and posterior communicating arteries functioned in the patient. Thus, they had optimal conditions for the use of a proximal device for the prevention of distal embolism, which made it possible to achieve a satisfactory outcome of hospitalization.

When performing brain revascularization in the acute period of ischemic stroke, it is necessary to take into account the recommendations of multicenter studies that report such conditions for a successful outcome of the operation as: the diameter of the ischemic focus in the brain, not exceeding 2.5 cm and the absence of severe neurological deficit (more than 2 points on a scale Rankin) [16–19]. Within the framework of this clinical example, these recommendations were taken into account, which, among other things, contributed to the optimal outcome of revascularization in the urgent mode.

CONCLUSION

Emergency stenting of tandem stenosis of the internal carotid artery using the *MoMa* device for proximal protection is effective in the obligatory presence of a closed circle of Willis structure. The technical complexity of the operation is associated with the installation of a guide catheter and its diameter of 9 *Fr* (catheters up to 7 *Fr are usually used*), which requires additional manual skills.

REFERENCES

1. Kazantsev AN, Chernykh KP, Zarkua NE, Lider RY, Burkova EA, Bagdavadze GS, et al. Immediate and long-term results of carotid endarterectomy in different periods of ischemic stroke. *IP Pavlov Russian Medical Biological Herald* . 2020;28(3):312–322. https://doi.org/10.23888/PAVLOVJ2020283312-322
2. Cukurova LA, Timchenko LV, Golovko EN, Usachev AA, Fedorchenko AP, Porkhanov VA. The successful urgent operations on brachiocephalic arteries at two patients in acute period of ischemic stroke. *Russian Journal of Neurosurgery.* 2013;(4):70–72. (In Russ.)
3. Kazantsev AN, Vinogradov RA, Kravchuk VN, Chernyavskiy MA, Shabaev AR, Kachesov EU, et al. Stenting of the first segment of the spinal artery in the acutest period of ischemic stroke in the vertebrobasilar territory. *Zhurnal Nevrologii i Psikhiatrii imeni SS Korsakova.* 2021;121(3–2):38–45. (In Russ.). https://doi.org/10.17116/jnevro202112103238
4. Zakirzhanov NR, Komarov RN, Khalilov IG, Bayazova NI, Evseeva VV. Comparative Analysis of Safety of Carotid Endarterectomy Performed in Acutest and Acute Periods of Ischaemic Stroke. *Angiology and Vascular Surgery.* 2021;27(1):97–106. (In Russ.). https://doi.org/10.33529/ANGIO2021103
5. Kazantsev AN, Chernykh KP, Lider RYu, Zarkua NE, Shabayev AR, Kubachev KG, et al. Emergency Glomus-Sparing Carotid Endarterectomy According to AN Kazantsev. *Russian Sklifosovsky Journal of Emergency Medical Care.* 2020;9(4):494–503. https://doi.org/10.23934/2223-9022-2020-9-4-494-503
6. Tarasov RS, Kazantsev AN, Moldavskaya IV, Burkov NN, Mironov AV, Lazukina IA, et al. In-hospital outcomes of carotid endarterectomy in acute period of ischemic stroke: single-center register data. *Kardiologiya i serdechno-sosudistaya khirurgiya* . 2018;11(5):60–65. (In Russ.). https://doi.org/10.17116/kardio20181105160
7. Kazantsev AN, Tarasov RS, Chernykh KP, Zarkua NE, Leader RY, Bagdavadze GSh, et al. A clinical case of treatment of a combined pathology: rupture of aneurysm of the middle cerebral artery against the background of stenosis of the internal carotid and coronary arteries. *Circulation Pathology and Cardiac Surgery* . 2020;24(2):109–118. (In Russ.) http://doi.org/10.21688/1681-3472-2020-2-109-118
8. Kazantsev AN, Khubulava GG, Kravchuk VN, Erofeev AA, Chernykh KP. Evolution of carotid endarterectomy: A literature review. *Circulation Pathology and Cardiac Surgery.* 2020;24(4):22–32. (In Russ.) http:// doi.org/10.21688/1681-3472-2020-4-22-32
9. Kazantsev AN, Tarasov RS, Burkov NN, Volkov AN, Grachev KI, Yakhnis EYa, et al. In-Hospital Outcomes of Transcutaneous Coronary Intervention and Carotid Endarterectomy in Hybrid and Staged Regimens. *Angiology and Vascular Surgery.* 2019;25(1):101–107. (In Russ.). https://doi.org/10.33529/angio2019114
10. Kazantsev AN, Tarasov RS, Burkov NN, Shabaev AR, Lider RYu, Mironov AV. Carotid Endarterectomy: Three-Year Results of Follow Up Within the Framework of a Single-Center Register. *Angiology and Vascular Surgery* . 2018;24(3):101–108. (In Russ.).
11. Darvish NA, Abdulgasanov RA, Shogenov MA, Abdulgasanova MR. Carotid endarterectomy and carotid artery stenting in the prevention of ischemic stroke. *Russian Annals of Surgery* . 2019; 24 (4): 245–52 (in Russ.). https://doi.org/10.24022/10.24022/1560-95022019-24-4-245-252
12. Alekyan BG, Bockeria LA, Golukhova EZ, Petrosyan KV, Darvish NA, Makhaldiani BZ. Postoperative and Long-Term Results in Patients With Atherosclerotic Lesions of the Internal Carotid Artery After Stenting and Carotid Endarterectomy. *Russian Journal of Endovascular Surgery* . 2021;8(1):27–36. (In Russ.). https://doi.org/10.24183/2409-40802021-8-1-27-36

13. Kazantsev AN, Burkov NN, Bayandin MS, Guselnikova YuI, Lider RYu, Yakhnis YeYa, et al. In-hospital outcomes of carotid artery stenting in patients with multifocal atherosclerosis. *Kardiologiya i Serdechno-Sosudistaya Khirurgiya.* 2020;13(3):224–229. (In Russ.) https://doi.org/10.17116/kardio202013031224
14. Natsional'nye rekomendatsii po vedeniyu patsientov s zabolevaniyami brakhiotsefal'nykh arteriy. *Angiology and Vascular Surgery.* 2013;19(2):4–68. (In Russ.).]
15. Kazantsev AN, Porkhanov VA, Khubulava GG, Vinogradov RA, Kravchuk VN, Chernyavsky MA, et al. Comparative Results of Emergency Carotid Endarterectomy and Emergency Carotid Angioplasty With Stenting in the Acute Period of Ischemic Stroke. Multicenter Study Results. *Russian Sklifosovsky Journal of Emergency Medical Care* . 2021;10(1):33–47. https://doi.org/10.23934/2223-9022-2021-10-1-33-47
16. Kazantsev AN, Vinogradov RA, Chernyavsky MA, Kravchuk VN, Matusevich VV, Chernykh KP, et al. Multicenter study: carotid endarterectomy in the first hours after ischemic stroke. *Russian Journal of Cardiology* . 2021;26(6):4316. (In Russ.) https://doi.org/10.15829/1560-4071-2021-4316
17. Kazantsev AN, Vinogradov RA, Chernyavsky MA, Matusevich VV, Chernykh KP, Zakeryaev AB, et al. Urgent intervention of hemodynamically significant stenosis of the internal carotid artery in the acutest period of an ischemic stroke. *Pathologiya Krovoobrashcheniya I Kardiokhirurgiya* . 2020;24(3S):89–97. (In Russ.). https://doi.org/10.21688/1681-3472-2020-3S-89-97
18. Kazantsev AN, Shabayev AR, Medvedeva EA, Shcherbinin AV, Chernykh KP, Lider RY, et al. Emergency Extra-Intracranial Microanastomosis After Carotid Endarterectomy Complicated With Thrombosis of the Internal Carotid Artery. *Russian Sklifosovsky Journal of Emergency Medical Care* . 2020;9(3):452–458. https://doi.org/10.23934/2223-9022-2020-9-3-452-458
19. Kazantsev AN, Chernykh KP, Artyukhov SV, Roshkovskaya LV, Janelidze MO, Bagdavadze GS, et al. Emergency glomus-saving autotransplantation of the internal carotid artery in the acute period of ischemic stroke. *Emergency Medical Care* . 2021;22(3):38–47. (In Russ.) https://doi.org/10.24884/2072-6716-2021-22-3-38-47
20. Alekyan BG, Zakaryan NV, Shumilina MV, Vartanov PV. Rezul'taty stentirovaniya pri patologii vnutrenney sonnoy arterii. *The Bulletin of Bakoulev Center. Cardiovascular Diseases.* 2010;11(S6):172. (In Russ.).
21. Korobkov AO, Volkov SV, Bagin SA, Lavrenko SV. Choice of cerebral protection devices for carotid stenting. *Bulletin of the Medical Institute "REAVIZ" (Rehabilitation, Doctor and Health)* . 2021;(1):29–37. (In Russ.) https://doi.org/10.20340/vmi-rvz.2021.1.CLIN.2
22. Khripun AV, Malevanyy MV, Kulikovskikh YaV, Fomenko EP, Lavnik DV, Demina AV, et al. Carotid Stenting With the Use of Proximal Cerebral Protection in Patients With Concomitant External Carotid Artery Disease. *Russian Journal of Endovascular Surgery* . 2016;3(2):78–82. (In Russ.)
23. Medvedev RB, Skrylev SI, Koshcheev AYu, Tanashyan MM. Ostrye ochagi ishemii golovnogo mozga posle karotidnoy angioplastiki so stentirovaniem. *Medica mente. Lechim s umom* . 2017;3(1):7–10. (In Russ.).
24. Khripun AV, Malevannyi MV, Kulikovskikh YaV. Results of Scanning of Internal Carotid Arteries Using the System of Proximal Cerebral Protection in the Immediate Postoperative Period. *Angiology and Vascular Surgery.* 2014;20(4):175–181. (In Russ.)

Received on 02/15/2022
Review completed on 07/14/2022
Accepted on 03/28/2023