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Effects of different types of carotid endarterectomy on the course of resistant arterial hypertension

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Abstract

Objective: Analysis of the dynamics of systolic blood pressure (SBP) and the results of various types of carotid endarterectomy (CEE) (classical with plasty of the reconstruction zone with a patch, eversion, formation of a new bifurcation, autoarterial reconstruction, glomus-saving techniques) in patients with resistant arterial hypertension (RAH).

Materials and methods: The actual cohort, comparative, retrospective, open research for the period from January 2013 to December 2021 includes 1577 patients with significant hemodynamic stenosis of the internal carotid artery Depending on revascularization strategy five groups were formed: Group 1: 18.3% (n = 289) – classical Carotid endarterectomy with plasty of the reconstruction zone with a patch (from diepoxy-treated xenopericardium or synthetic); Group 2: 29.9% (n = 472) – eversional CEE with cut-off of carotid gloomus (CG); Group 3: 6.9% (n = 109) – the formation of a new bifurcation; Group 4: 7.4% (n = 117) - autoarterial reconstruction; Group 5: 37.4% (n = 590) – glomus-saving CEE (1 technique – according to A.N. Kazantsev; two technicians – according to R.A. Vinogradov; three technicians – according to K.-A.Antsupov). According to the 24-h blood pressure monitor in the preoperative period, the following degrees of AH were identified: 1° – 5.7% (n = 89); 2° – 64.2% (n = 1013); and 3° – 30.1% (n = 475).

Results: In the postoperative period, no significant differences were obtained in the frequency of deaths, myocardial infarction, stroke, hemorrhagic transformation. However, according to the frequency of the combined endpoint (death + myocardial infarction + ischemic stroke + hemorrhagic transformation), the lowest rates were observed in the group of classical carotid endarterectomy with plasty of the reconstruction zone with a patch and glomus-sparing CEE (group 1: 1.03% (n = 3); group 2: 3.6% (n = 17); group 3: 3.67% (n = 4); group 4: 2.56% (n = 3); group 5: 0.5% (n = 3); p = 0.10). This is due to the absence of cases of labile AH and hypertensive crises among patients of groups 1 and 5, which was ensured by the preservation of carotid glomus (CG). As a result, the number of patients with 2 and 3 degrees of hypertension in these groups decreased statistically significantly. The vast majority of patients after these operations achieved a stable target SBP.

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In groups 2, 3, and 4, there was a statistically significant increase in the number of patients with 2 and 3 degrees of AH, which is associated with excision of the CG

Conclusion: Classical CEE and glomus-sparing CEE techniques make it possible to achieve a stable target SBP level in patients with RAH as a result of CG preservation. Removal or traumatization of the latter during eversional CEE, the formation of a new bifurcation, autoarterial reconstruction is accompanied by the development of labile hypertension, an increase in the degree of hypertension and a high risk of hemorrhagic transformation in the brain. Thus, the most effective and safe types of CEE in the presence of RAH are classical CEE with plasty of the reconstruction zone with a patch and glomus-sparing CEE, accompanied by the lowest incidence of adverse cardiovascular events caused by postoperative hypertensive crisis and hyperperfusion syndrome.

Keywords

Carotid endarterectomy, classical carotid endarterectomy, eversion carotid endarterectomy, resistant arterial hypertension, arterial hypertension, labile arterial hypertension, patch, hemorrhagic transformation

Introduction

Carotid endarterectomy (CEE) takes the position of one of the most common vascular operations in modern angiosurgery.[1–5] The typical contingent of patients undergoing this intervention most often suffers from coronary heart disease, diabetes mellitus, multifocal atherosclerosis (MFA), chronic renal insufficiency and other comorbid conditions.[6–10] At the same time, the importance of hemodynamically significant stenosis correction may exceed the necessity for full compensation of concomitant pathology (poorly controlled diabetes, uncompensated arterial hypertension), if it comes to, for example, subocclusion or unstable atherosclerotic plaque in the internal carotid artery (ICA).[2,5,8–10] A separate question raises the justification of CEE in patients with resistant arterial hypertension (RAH), the number of which, according to a number of studies, reaches 40% of the total patient sample.[11–15] On the one hand, high blood pressure (BP) can become one of the pathophysiological links of hyperperfusion syndrome formation and further adverse cardiovascular events.[16,17] On the other hand, it is known that the carotid glomus (CG), which is a kind of bridge between chemo- and baroreceptors and the vasomotor center, is also responsible for the homeostasis of BP in the body.[18–20] Thus, its damage or preservation during CEE can affect the course of RAH.

Recommendations of the European Society of Cardiology and the European Society of Hypertension on new methods of hypertension treatment – 'Device-based treatment', pay special attention to surgical and endovascular ablation of carotid bodies, as a result of which the authors expect a decrease of general sympathetic tone and BP level.[21,22] But the effect of this technique is traceable only under conditions of high excitation of the carotid body, in another situation, the result can aggravate the course of RAH.[23] However, the recommendations themselves state that this treatment option has a number of significant limitations due to the small number of presented observations and the high embolization risk.[21,22] In this regard, today endovascular methods require additional study.[21,22] A significant limitation is the absence of objective methods of assessment high carotid body tone, therefore interventional operation precisely for the purpose of influencing blood pressure rather than ICA stenosis, will be performed 'at random': if carotid body tone is normal, but the ablation procedure will be performed, the connection between the CG and the vasomotor center will be disrupted, leading to an even more BP rising.[21–23]

Against this background, patients heading for CEE and suffering from RAH are of particular interest. The operation itself can be accompanied by both the preservation of the CG (with the implementation of glomus-saving CEE, classical CEE with plasty of the reconstruction zone with patch) and its removal (eversion CEE, the formation of a new bifurcation and autoarterial reconstruction).[3,18,20,24,25] In terms of the frequency of adverse cardiovascular events at different stages of observation, these surgical techniques are well studied and each of them has certain indications for implementation. However, the fact of the presence of RAH has never been considered as a condition for a particular type of reconstruction.[26–31] Today, there are not enough studies reflecting the impact of various types of CEE on the course of RAH in the postoperative period.[32–35] Removal of ASP with preserved CG will lead to an amplitude increase of pulse oscillations of the vessel wall with activation of carotid sinus baroreceptors and a further BP decrease.[19,20,27,28] However, the removal of CG in the presence of RAH can aggravate the course of the latter with the formation of a hypertensive crisis and further adverse events similar to ablation in conditions of normal carotid body tone.[18,19,20,23,29] Thus, today there is a shortage of works demonstrating the dynamics of BP in patients with RAH after different types of CEE.

The aim of this work was to evaluate the dynamics of systolic BP and the results of various CEE techniques

(classical CEE with plasty of the reconstruction zone with patch, eversion CEE, formation of a new bifurcation, autoarterial reconstruction and glomus-saving CEE techniques) in patients with RAH

Materials and methods

This cohort, comparative, retrospective, open-label study for the period from January 2013 to December 2021 included 1577 patients with hemodynamically significant stenoses of ICA and RAH for more than 3 years. RAH was defined as a pathological condition in which lifestyle change in combination with taking ≥3 antihypertensive drugs do not normalize BP (target values 140/90 mmHg), or reaching these values is possible after taking ≥4 antihypertensive drugs.[21]

There are 3 degrees of arterial hypertension:

(1) degree arterial hypertension: systolic blood pressure 140–159 mm Hg. Art., diastolic blood pressure 90–99 mm Hg. Art.
(2) degree arterial hypertension: systolic blood pressure 160–179 mm Hg. Art., diastolic blood pressure 100–109 mm Hg. Art.
(3) degree of arterial hypertension: systolic blood pressure more than 180 mm Hg. Art., diastolic blood pressure more than 110 mm Hg. Art.

Depending on the implemented revascularization strategy, 5 groups were formed: Group 1: 18.3% (n = 289) – classical CEE with plasty of the reconstruction zone with a patch (from diepoxy-treated xenopericardium or synthetic); Group 2: 29.9% (n = 472) – eversional CEE with cut-off of CG; Group 3: 6.9% (n = 109) – the formation of a new bifurcation; Group 4: 7.4% (n = 117) – autoarterial reconstruction; and Group 5: 37.4% (n = 590) – glomus-saving CEE.

The inclusion criteria were: (1) Indications for CEE according to the current recommendations (symptomatic ICA stenosis of 60% or more according to angiography; asymptomatic ICA stenosis of 70% or more according to angiography); (2) Presence of RAH established according to current recommendations for arterial hypertension[21]; (3) RAH length exceeding 3 years; (4) Glomerular filtration rate >80 months/min/1.73 m^2, blood creatinine <90 mmol/L). All patients underwent hormonal testing, and color duplex scanning of the renal arteries was performed in all cases; (5) Absence of pathological conditions in the adrenal glands, including pheochromocytomas; (6) Absence of diabetes mellitus; (7) Absence of traumatic brain injury; (8) Absence of peracute and acute periods of ischemic stroke; (9) Absence of planned simultaneous heart surgery in combination with CEE; and (10) Absence of planned hybrid surgery: percutaneous coronary intervention + CEE. The exclusion criteria implied indicators that did not meet the above inclusion points.

According to the daily BP monitoring, the following degrees of hypertension were revealed in the preoperative period: 1°–5.7% (n = 89); 2°–64.2% (n = 1013), 3° - 30.1% (n = 475). To study the dynamics of mean systolic blood pressure (SBP), BP was measured (during the patient's stay in intensive care - according to bedside monitoring of BP in the patient's lying position; in the department - 10 times a day daily (from 9:00 to 21:00 with an interval every hour);in the preoperative period for 4 days in the patient's sitting position; and in the postoperative period for 10 days. Blood pressure measurement was performed by a post nurse, whose job descriptions include this manipulation. The data were recorded in a special observation form in the patient medical histories. The average SBP (daily) figures for all patients were taken into account when plotting BP fluctuation graph.

In its turn, the autoarterial reconstruction was performed according to the mirror technique, that is, the ICA was cut-off as the first stage instead of ECA.[24] Further, the course of the operation was identical (Figure 1). Both the formation of a new bifurcation and autoarterial reconstruction implied the cutting off the CG.

The largest group of glomus-saving CEE included patients who underwent three surgical techniques differing in the method of arteriosection but identical in the main idea - removal of ASP from the ICA without CG traumatization. Among them: CEE according to A.N. Kazantsev, CEE according to R.A. Vinogradov, CEE according to K.A. Anzupov (Figure 2).[18,19,28]

The endpoints were understood as the development of such adverse cardiovascular events as lethal outcome,

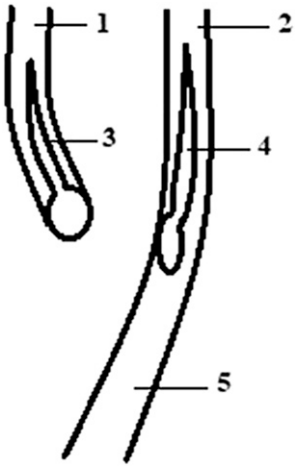

Figure 1. Autoarterial reconstruction. Note: 1 – external carotid artery, 2 – internal carotid artery, 3 – longitudinal dissection of the external carotid artery, 4 – projection of arteriotomy of the internal carotid artery, 5 – common carotid artery.

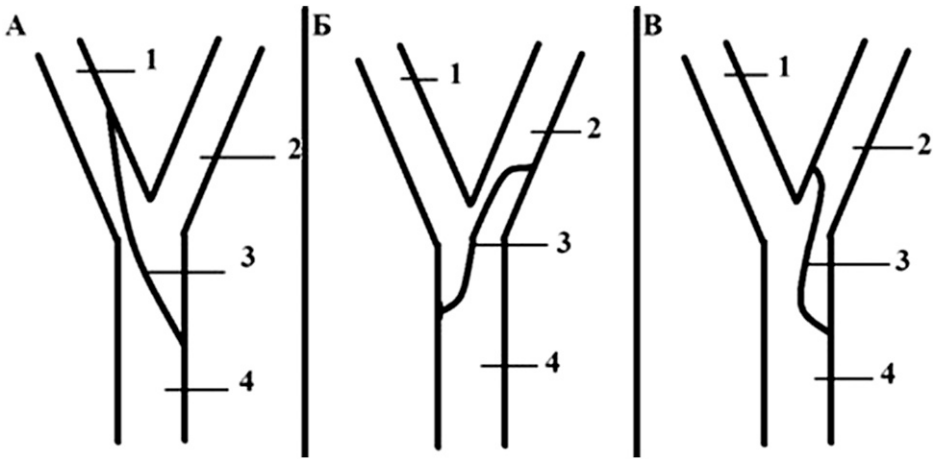

Figure 2. Glomus-sparing techniques for carotid endarterectomy. Note: A – Glomus-saving CEE according to A.N. Kazantsev; B - Glomus-saving CEE according to R.A. Vinogradov; B - Glomus-saving technique according to K. A. Antsupov; 1 – external carotid artery; 2 – internal carotid artery; 3 – arteriotomy line; 4 – common carotid arteries.

myocardial infarction (MI), acute cerebrovascular accident/transient ischemic attack (ACVA/TIA), thrombosis in the reconstruction area, bleeding type 3b and higher according to the Bleeding Academic Research Consortium (BARC) scale and combined endpoint (death + ACVA/TIA + hemorrhagic transformation + MI).

The study was carried out in accordance with the standards of Good Clinical Practice and the principles of the Declaration of Helsinki.

The data agreement with normal distribution was performed using Kolmogorov–Smirnov criterion. The analysis to check the overall statistical homogeneity of all groups was carried out using the Kraskel–Wallis criteria and Pearson chi-squared. The differences were assessed as significant at $p < 0.05$. In the presence of differences between all groups in one of the parameters or an indicator 'p' close to 0.05, a pairwise comparison of the groups was performed using the Mann–Whitney and Pearson chi-square with Yates correction. The research results were processed using the GraphPad Prism application software package (https://www.graphpad.com).

The groups were comparable in all clinical and anamnestic characteristics. The vast majority were male and elderly. Every fifth had a history of MI, every third – an ischemic stroke. Thus, CEE was performed in 30.8% (n = 486) of symptomatic patients in the present study. The assessment of the risk stratification of complications and the severity of the comorbid background corresponded to the average severity on the EuroSCORE II scale. (Table 1)

Results

There were no significant intergroup differences in the analysis of angiographic characteristics. However, it should be noted that in the vast majority of cases, the degree of ICA stenosis was approaching subocclusion, and unstable ASP was visualized in 41.1% of the entire sample (Table 2). Such circumstances, due to the high risk of ischemic stroke, by the decision of the multidisciplinary consilium, allowed to conduct CEE in this cohort of patients in an accelerated manner, despite the presence of uncompensated RAH.

In the hospital postoperative period, all lethal outcomes were recorded in groups 1 and 2. The cause of death after an eversion CEE with the CT intersection in all three cases was hemorrhagic transformation of an ischemic focus (CEE was performed in the presence of symptomatic stenosis in the early recovery period of ACVA) in the brain with edema and brainstem insertion against the background of critical figures of HT (up to 200/100 mmHg) and hyperperfusion syndrome. The cause of fatal outcome after classical CEE was IM. There were no intergroup differences in the frequency of development of non-fatal MI. Statistically significant differences were also not found by analyzing of the frequency of ischemic stroke formation. However, it should be noted that the difference between the group of patients after the eversion CEE with the intersection of CG and the group of glomus-saving CEE was 0.06, which still indicates a protective mechanism of CG preservation with regard to cerebral accidents. In groups 2, 3 and 4, all ACVA/TIA were obtained against the background of a hypertensive crisis and labile hypertension in the postoperative period. In group 1, the cause of ischemic stroke was ICA thrombosis as a result of intimal detachment distal to the endarterectomy zone. In group 5 – distal embolism after the insertion of TS (Table 3).

All hemorrhagic transformations developed after the implementation of an eversion CEE with the intersection of CG, new bifurcation formation and autoarterial reconstruction against the background of high critical BP values and hyperperfusion syndrome (Table 3).

Table 1. Comparative clinical and anamnestic characteristics of patient groups.

	Groups					
	Group 1	Group 2	Group 3	Group 4	Group 5	
Indicator	*n* =289	*n* = 472	*n* = 109	*n* = 117	*n* = 590	p
Age, M ± m, years	65.3 ± 3.1	65.4 ± 4.0	64.9 ± 5.1	63.7 ± 5.2	65.4 ± 5.6	0.27
Male, *n* (%)	215 (74.4)	339 (71.8)	79 (72.4)	84 (71.8)	429 (72.7)	0.95
CHF I-II type by NYHA, *n* (%)	128 (44.3)	218 (46.2)	49 (44.9)	53 (45.3)	274 (46.4)	0.97
PICS, *n* (%)	54 (18.7)	86 (18.2)	21 (19.3)	24 (20.5)	118 (20.0)	0.94
COPD, *n* (%)	2 (0.7)	4 (0.8)	1 (0.9)	0	5 (0.8)	0.90
MFA with hemodynamically significant lesion of three arterial basins, *n* (%)	183 (63.3)	294 (62.3)	68 (62.4)	72 (61.5)	377 (63.9)	0.98
LVEF, M ± m, %	58.8 ± 4.1	58.2 ± 6.0	59.5 ± 6.3	57.1 ± 6.6	57.7 ± 6.2	0.82
Left ventricular aneurysm, *n* (%)	0	2 (0.4)	0	0	3 (0.5)	0.64
EuroSCORE II, M ± m	2.5 ± 0.7	2.6 ± 1.0	2.7 ± 0.8	2.3 ± 0.5	2.7 ± 0.8	0.64
PCI in anamnesis, *n* (%)	38 (13.1)	67 (14.2)	15 (13.4)	16 (13.7)	78 (13.2)	0.99
CABG in anamnesis, *n* (%)	9 (3.1)	14 (2.9)	3 (2.7)	4 (3.4)	16 (2.7)	0.99
ACVA/TIA in anamnesis, *n* (%)	90 (31.1)	146 (30.9)	35 (32.1)	37 (31.6)	178 (30.2)	0.99

Note: CHF: chronic heart failure, FC: functional class, PICS: postinfarction cardiosclerosis, DM: diabetes mellitus, HP: hypertension, COPD: chronic obstructive pulmonary disease, CRD: chronic kidney disease, MFA: Multifocal atherosclerosis, LVEF: left ventricular ejection fraction, PCI: percutaneous coronary intervention, CABG: coronary artery bypass graft, ACVA: acute cerebrovascular accident, TIA: transient ischemic attack.

Table 2. Angiographic and perioperative characteristics.

	Groups					
	Group 1	Group 2	Group 3	Group 4	Group 5	
Indicator	*n* =289	*n* = 472	*n* = 109	*n* = 117	*n* = 590	p
% of ICA stenosis	89.4 ± 7.7	85.6 ± 9.1	88.3 ± 7.2	86.5 ± 8.2	87.7 ± 4.9	0.33
Unstabled АСБ, *n* (%)	115 (39.8)	195 (41.3)	44 (40.4)	49 (41.9)	248 (42.0)	0.97
SYNTAX score taking into myocardial revascularization in anamnesis, M ± m	13.3 ± 2.7	10.1 ± 3.4	11.8 ± 4.1	11.5 ± 3.9	12.4 ± 3.8	0.47
ICA clamping time, minute	26.2 ± 3.1	25.4 ± 2.8	28.3 ± 4.0	28.1 ± 3.8	27.5 ± 2.9	0.81

Note: ICA: internal carotid artery, ECA: external carotid artery, ASP: atherosclerotic plaque, TS: temporary shunt.

According to the frequency of the combined endpoint, the lowest values were obtained in the groups of classical and glomus-sparing CEE. This is due to the absence of labile HP cases hypertensive crises among these patients (Table 3).

When analyzing the dynamics of BP after different types of CEE, the following is noteworthy. As a result of the preservation of CG during the classical CEE and glomus-saving CEE, the number of patients with 2 and 3 degrees of HP in these groups significantly decreased statistically. The vast majority of patients reached a stable target BP level after these operations. In groups 2, 3 and 4, there was a statistically significant increase in the number of patients with 2 and 3 degrees of HP, which is associated with excision of CG (Table 4).

There are several facts that attract attention in analysis of SBP graph. (1) In the preoperative period, during 4 days of observation in the clinic, all patients recorded stable maximum indicators without a significant downward trend against the background of ongoing therapy, including more than 4 antihypertensive drugs; (2) In the postoperative period, patients with the implementation of classical CEE with plasty of the reconstruction zone with a patch and glomus-saving CEE had a persistent decrease of SBP level with stabilization and reaching of the target level on the sixth day; (3) After eversion CEE with the CG removal, new bifurcation formation and autoarterial reconstruction there was an SBP increase critical values throughout the post-operative observation during the first 3 days. Subsequently, labile HP was diagnosed without reaching stable target values; (4) In the same groups, the average SBP level exceeded the indicators of the preoperative period at the time of discharge; (5) On the second–-third day in all the

Table 3. Hospital outcomes.

	Groups					
	Group 1	Group 2	Group 3	Group 4	Group 5	
Indicator	*n* =289	*n* = 472	*n* = 109	*n* = 117	*n* = 590	p
Death, *n* (%)	1 (0.34)	3 (0.63)	0	0	0	0.29
MI (non-fatal), *n* (%)	1 (0.34)	4 (0.84)	2 (1.83)	1 (0.85)	2 (0.33)	0.38
ACVA/TIA (non-fatal), *n* (%)	1 (0.34)	6 (1.27)	1 (0.91)	1 (0.85)	1 (0.17)	0.08
Hemorrhagic transformation, *n* (%)	0	4 (0.84)	1 (0.91)	1 (0.85)	0	0.10
Bleeding type 3b and higher according to the BARC scale, *n* (%)	1 (0.34)	5 (1.05)	0	0	2 (0.33)	0.34
ICA thrombosis, *n* (%)	1 (0.34)	1 (0.21)	0	0	0	0.66
Combined endpoint, *n* (%)	3 (1.3)	17 (3.60)	4 (3.67)	3 (2.56)	3 (0.50)	0,0022

Note: MI: myocardial infarction, ACVA: acute cerebrovascular accident, TIA: transient ischemic attack, ICA: internal carotid artery, *p* (o): general statistical difference for all groups, G: Group.

Table 4. The severity of arterial hypertension depending on the period and type of surgery.

		Number of patients				
HP degree		Before CEE	After CEE	p	OR	95% CI
Classical CEE	Achieving the target BP level, *n* (%)	0	205 (70.9)	<0.0001	0.0007	2.13–25.1
	1, *n* (%)	15 (5.2)	48 (16.6)	<0.0001	0.27	0.15–0.50
	2, *n* (%)	161 (55.7)	15 (5.2)	<0.0001	21.3	12.1–37.59
	3, *n* (%)	113 (39.1)	21 (7.3)	<0.0001	8.19	4.95–13.55
Eversion CEE	Achieving the target BP level, *n* (%)	0	0	—	—	—
	1, *n* (%)	32 (6.8)	8 (1.7)	0.0002	4.21	1.92–9.25
	2, *n* (%)	304 (64.4)	240 (50.8)	<0.0001	1.74	1.34–2.27
	3, *n* (%)	136 (28.8)	224 (47.5)	<0.0001	0.44	0.34–0.58
New bifurcation formation	Achieving the target BP level, *n* (%)	0	0	—	—	—
	1, *n* (%)	12 (11.0)	1 (0.9)	0.004	13.36	1.58–90.74
	2, *n* (%)	73 (67.0)	49 (45.0)	0.0017	2.48	1.43–4.30
	3, *n* (%)	24 (22.0)	59 (54.1)	<0.0001	0.23	0.13–0.43
Autoarterial reconstruction	Achieving the target BP level, *n* (%)	0	0	—	—	—
	1, *n* (%)	9 (7.7)	2 (1.7)	0.06	4.79	1.01–22.69
	2, *n* (%)	80 (68.4)	49 (41.9)	<0.0001	3.0	1.75–5.12
	3, *n* (%)	28 (23.9)	66 (56.4)	<0.0001	0.24	0.13–0.42
Glomus-saving CEE	Achieving the target BP level, *n* (%)	0	463 (78.5)	<0.0001	0.00023	2.16–22.5
	1, *n* (%)	21 (3.5)	37 (6.3)	0.04	0.55	0.31–0.95
	2, *n* (%)	395 (66.9)	58 (9.8)	<0.0001	18.58	13.48–25.6
	3, *n* (%)	174 (29.5)	32 (5.4)	<0.0001	7.29	4.89–10.86

Note: BP: blood pressure, AH: arterial hypertension.

groups, regardless of the removal or preservation of CG, SBP rise was observed due to local inflammation and tissue edema (Figure 3).

Discussion

Authors have demonstrated that CEE with preserved CG provokes labile HT in about 21–50% of cases and suggested using blockade of the latter with local anesthetics.[34] In a study led by Marrocco-Trischitta MM, it was proved that during CEE with preservation of CG, a BP increase can be noted due to local inflammation with subsequent stabilization.[35] However, most often labile HT is not observed, and the exclusion of CG injury has a protective effect.[35] BP dynamics in 276 patients after classical CEE with plasty of reconstruction zone with a patch and eversion CEE with CG trauma were compared in Demirel S work.[36] Despite the lower preoperative mean systolic BP in the group of eversion CEE (130 mmHg. Against 135 mmHg, $p = 0.02$) in the postoperative period, a statistically significant negative dynamics with a tendency to labile HT (134 mmHg

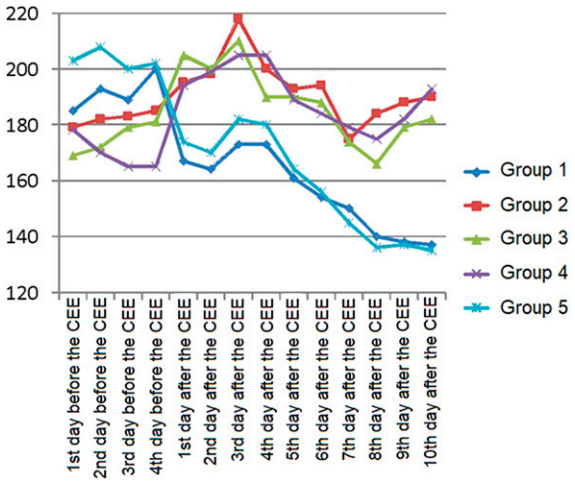

Figure 3. Graph of the dynamics of systolic blood pressure in the pre- and postoperative period after different types of carotid endarterectomy.

versus 126 mmHg, $p < 0.0001$) was observed for 4 days. Thus, the authors demonstrated the importance of preserving CG in achieving the target level of postoperative BP.[36] Taurino M with coauthors in their work have demonstrated BP dynamics after the standard eversion CEE and the eversion CEE according to the Chevalier technique, not implying CG crossing.[37] The results of the study showed that the preservation of the carotid body and the baroreceptor apparatus prevents postoperative hypertensive crisis and specifically contributing to BP decrease in RAH.[37] Thus, such a pattern became the impetus for the development of new methods of eversion CEE with the preservation of CG, which were presented in our article. The reconstruction variants developed by K.A. Antsupov, R.A. Vinogradov and A.N. Kazantsev have gained the greatest recognition in the Russian Federation.[18–20,28,29] The authors have repeatedly proved in their works that absence of carotid body traumatization and removal is a protective factor for BP stabilization and reduction in RAH.[18–20,28,38] Prevention of labile hypertension formation, according to the results of their studies, contributes to a significant decrease in the number of adverse cardiovascular events caused by hyperperfusion syndrome against the background of postoperative hypertensive crisis.[18–20,28,38]

Thus, generalizingthe results of the presented works, it can be concluded that the removal or traumatization of CG is more likely to lead to an BP increase and lability, which in the conditions of RAH can form a negative background for the development of adverse cardiovascular events. Stabilization and/or BP decrease after removal of CG is rather nonsense and is noted only in isolated studies not allowing to apply these tactics routinely with full confidence.

Conclusion

Classical CEE and glomus-sparing CEE techniques make it possible to achieve a stable target SBP level in patients with RAH as a result of CG preservation. Removal or traumatization of the latter during eversional CEE, the formation of a new bifurcation, autoarterial reconstruction is accompanied by the development of labile HT, an increase in the degree of HT and a high risk of hemorrhagic transformation in the brain. Thus, the most effective and safe types of CEE in the presence of RAH are classical CEE with plasty of reconstruction zone with a patch and glomus-saving CEE, accompanied by the lowest incidence of adverse cardiovascular events caused by postoperative hypertensive crisis and hyperperfusion syndrome. The authors recommend that changes be made to the current recommendations – patients with carotid stenosis should only undergo glomus-sparing or classical CEE.

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