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Review

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Carotid Endarterectomy and Stenting of the Internal Carotid Artery in Patients with Occlusion of the Contralateral Carotid Artery

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ABSTRACT The results of studies investigating the impact of contralateral carotid occlusion (CCO) in patients with carotid stenosis who have undergone endarterectomy or stenting vary in the literature. We aimed to determine which approach is the optimal revascularization strategy for those patients.

THE AIM OF STUDY To review the current scientific literature reflecting the outcomes of patients with CCO and to determine whether the presence of CCO plays a prognostic role in perioperative outcomes in patients undergoing carotid revascularization with endarterectomy or stenting.

MATERIAL AND METHODS Literature sources from Pubmed and MEDLINE, Scopus and Cochrane information aggregators on this topic published in Russian and English between 2003 and 2023 were selected for analysis. The terms of contralateral carotid occlusion, stenting of the single carotid artery, carotid endarterectomy, endovascular treatment for stenosis of the single carotid artery, surgery of the single carotid artery, carotid and (stent or stenting) and endarterectomy and (contralateral or bilateral) and occlusion were included in the analysis.

An observational or randomized study was considered eligible for inclusion only if it met all specified inclusion criteria: (1) carotid revascularization outcomes were compared in patients with and without CCO; (2) quantitative data on clinical outcomes of interest were provided; and (3) the study was published before September 2023. Studies that did not meet any of these criteria were not eligible for inclusion. Common exclusion criteria were carotid revascularization performed concurrently with coronary revascularization, acutely developing stroke, spontaneous carotid dissection or fibromuscular dysplasia.

RESULTS 35 literature sources were analyzed. The review article presents the world experience of surgical treatment (carotid endarterectomy and stenting of the internal carotid artery) in patients with haemodynamically significant stenosis and contralateral carotid occlusion. Some papers indicate the advantages of endovascular operations in elderly patients, others - carotid endarterectomy. The accumulation of experience in treatment of this category of patients should help either in optimization or in individualization of surgical tactics.

CONCLUSION Surgical intervention in patients with haemodynamically significant stenosis of the internal carotid artery and contralateral occlusion should be differentiated and have an individual approach.

Keywords: stenting of the single carotid artery, contralateral carotid artery occlusion, carotid artery stenting, carotid endarterectomy in patients with contralateral carotid artery occlusion

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CAS — carotid artery stenting
CCO — contralateral carotid occlusion
CEA — carotid endarterectomy
CI — confidence interval
MI — myocardial infarction
OR — odds ratio
RD — risk difference
TIA — transient ischemic attack

INTRODUCTION

Ischemic stroke is the fifth leading cause of death and the largest cause of long-term disability in the adult population [1, 2, 3]. Extracranial stenosis of the internal carotid artery is the cause of approximately 11.5% of all ischemic strokes, or 500 thousand strokes per year in the Russian Federation [2,4]. Carotid artery revascularization procedures are essential interventions for primary and secondary stroke prevention along with optimal medical treatment.

Carotid artery stenting (CAS) is increasingly used as a minimally invasive alternative to carotid endarterectomy (CEA), the gold standard of open surgery. A number of randomized clinical trials have attempted to evaluate the efficacy and safety of both procedures [5, 6,7].

Most of these randomized controlled trials recommended clinical equivalence of these procedures, although careful interpretation of the results, inclusion criteria, and definition of the primary endpoint is necessary. Thus, it is very important to choose the optimal interventional strategy for patients depending on their comorbidities.

A special risk group is patients with contralateral carotid occlusion (CCO), which accounts for approximately 8–10% of cases with carotid artery stenosis. CCO has historically been considered a sign of increased risk when performing CEA, as it is associated with an increased risk of adverse events, primarily stroke in the perioperative period. In contrast, CCO has not been shown to increase the risk of adverse events in patients undergoing CAS. Therefore, CCO is traditionally a reason for referral for CAS [5,8,9].

On the other hand, recent observational data have cast doubt on whether CEA is still inferior to CAS among patients with CCO in contemporary practice.

SEARCH STRATEGY AND SELECTION CRITERIA

The PubMed, Scopus, and Cochrane databases were searched from 2003 to 2023 to identify papers relevant to the research question.

The condition for including articles in the analysis were the presence of the terms: “contralateral carotid occlusion”, "stenting of a single carotid artery", "carotid endarterectomy", "endovascular treatment of stenosis of a single carotid artery", "surgery of a single carotid artery", "carotid and (stent or stenting) and endarterectomy and (contralateral or bilateral) and occlusion".

An observational or randomized study was considered eligible for inclusion only if it met all specified inclusion criteria: (1) the outcomes of carotid revascularization in patients with and without CCO were compared; (2) quantitative data on the clinical outcomes of interest were provided; (3) the study was published before September 2023. Works that did not meet any of the above criteria were excluded. General exclusion criteria were carotid revascularization performed simultaneously with coronary revascularization, acute stroke, spontaneous carotid artery dissection, or fibromuscular dysplasia.

LITERATURE REVIEW

In 2017, Nejim B. et al. [10] conducted one of the first multicenter retrospective analyses of prospectively collected data from the Vascular Quality Initiative (VQI) of all patients with contralateral carotid occlusion who underwent CEA

or CAS. Overall, 4326 patients had contralateral carotid occlusion (CEA 3274 (75.7%) vs. CAS 1052 (24.3%)).

Patient demographics and comorbidities were generally similar in both groups. History of stroke was twice as common in patients who underwent CEA (56.4 vs. 24.0%; P<0.001). Patients with CAS were more likely to have ipsilateral symptoms (41.2 vs. 24.2%; P<0.05). In asymptomatic patients, short-term outcomes and 2-year ipsilateral stroke risk did not differ significantly between CAS and CEA, however, the adjusted risk of any stroke or death within 2 years was 42% higher with the use of CAS (adjusted odds ratio (OR)=1.42, 95% confidence interval (CI) [1.08–1.86], P=0.011).

In symptomatic patients, CAS was associated with a nearly three-fold increase in the risk of 30-day stroke (OR = 2.90; 95% CI [1.06 to 7.94], P = 0.038), and a more than six-fold increase in 30-day mortality (OR = 6.10, 95% CI [2.20–16.92], P = 0.001). The risk of stroke in the first 2 years after surgery was 94% higher in patients with CAS compared with patients with CEA (adjusted OR = 1.94, 95% CI [1.18–3.19], P = 0.009). In this large cohort of patients with contralateral carotid occlusion, CAS did not show better results than CEA in asymptomatic patients, and had significantly worse results in patients with perioperative symptoms. The 2-year stroke rate was similar for both procedures, but the risk of stroke or death was significantly higher in patients after CAS. The authors conclude that in patients with contralateral carotid occlusion, stenting is not safer than CEA.

Texakalidis P. et al. (2018) [7] published their systematic review and meta-analysis comparing endarterectomy with stenting in patients with contralateral carotid occlusion. Five retrospective observational cohort studies comprising 6346 patients were included. Patients in the CEA group had a significantly lower risk of 30-day periprocedural mortality (OR=0.46, 95% CI [0.30–0.71], I2=0%). However, no significant differences were found in stroke, myocardial infarction (MI), and major adverse cardiovascular events between the two groups. Subgroup analysis of symptomatic and asymptomatic patients revealed no significant differences in stroke, MI, and mortality. In conclusion, the authors state that patients with CCO can safely undergo both CAS and CEA with the same risk of stroke or MI. However, patients undergoing CEA have a lower risk of 30-day periprocedural mortality.

A meta-analysis comparing the safety and efficacy of carotid endarterectomy and carotid artery stenting in patients with contralateral carotid occlusion was conducted by Xin W.Q. et al. (2019) [11]. It included 4 retrospective cohort studies involving 6252 patients with contralateral carotid occlusion. During the 30-day follow-up, there was a significant difference in mortality after the procedure (OR=0.476, 95% CI [0.306–0.740], P = 0.001). No significant differences were found in post-procedure stroke (odds difference (OD) = 0.002, 95% CI [0.007–0.011]; P = 0.631), myocardial infarction (OD = 0.003, 95% CI [–0.002–0.008]; P = 0.301), and transient cerebral ischemia (OD = 1.059, 95% CI [–0.188–5.964], P = 0.948).

The results obtained allow us to conclude that carotid endarterectomy was associated with a lower mortality rate compared with stenting in patients with contralateral carotid occlusion. Regarding stroke, MI and transient ischemic attack (TIA), there was no significant difference between the two groups.

Another meta-analysis, by Sun Y. et al. (2021) [12], compared the effects of carotid endarterectomy and carotid artery stenting for contralateral carotid occlusion. Six studies involving 6953 patients were selected for inclusion in this meta-analysis. This research showed that although CEA was associated with an increased risk of stroke compared with CAS (OR=1.07, 95% CI [0.75–1.51], P=0.713), CEA was associated with a reduced risk of death compared with CAS (OR=0.45; 95% CI [0.29–0.70], P<0.001). Furthermore, no significant differences were found between CEA and CAS in the risks of MI (OR=1.38, 95% CI [0.73–2.62], P=0.319) or major adverse cardiovascular events (OR=1.03, 95% CI [0.56–1.88], P=0.926). Finally, the risk of MI for CEA compared with CAS was dependent on disease status, whereas the risk of major adverse cardiovascular events was dependent on the proportion of patients being male, having coronary heart disease, and being a current or former smoker. This study showed that CEA and CAS resulted in similar outcomes for patients with CCO, while the risk of death was reduced in patients undergoing CEA.

However, these analyses have several important limitations. First, the studies were conducted in surgical quality improvement registries, where CAS

is often underrepresented compared to CEA. Furthermore, these registries include mainly vascular surgeons, while other clinical specialties are not represented. Finally, patients with CCO referred for CEA may be a healthier group than patients who underwent CAS.

In support of this, the North American Symptomatic Carotid Endarterectomy Trial (NASCET) [13] reported an increased risk of perioperative stroke in patients with CCO who underwent CEA compared with patients without CCO. The Asymptomatic Carotid Atherosclerosis Study (ACAS) [14] also reported an increased risk of perioperative stroke in this group of patients. However, the data obtained in the NASCET and ACAS studies were limited by the small total number of patients with CCO. In addition, there are limited data on the comparative outcomes of CAS and CEA among patients in this group. In turn, Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (SAPPHIRE) and Clinical Impact of Contralateral Carotid Occlusion in Patients Undergoing Carotid Artery Revascularization studies, which included two large patient registries – NCDR CARE (National Cardiovascular Data Registry Carotid Artery Revascularization and Endarterectomy) and PVI (Peripheral Vascular Intervention) – recognized CCO as a high-risk criterion for CEA, and suggested better outcomes after CAS [5].

In 2005, González A. et al. [9] analyzed the treatment outcomes of 96 patients with contralateral occlusion. The mean age was 64±9 (range 40–80), 85 (88.5%) were male, and 61 (63.5%) were symptomatic. 25 patients (26%) underwent CEA, and 71 (74%) underwent CAS. Distal protection was used in 38 patients (39.6%). Asymptomatic stenosis was treated in cases of progression (>85%), exhausted vasoreactivity, positive microemboli detection in transcranial Doppler, and/or asymptomatic lesions in computed tomography or magnetic resonance imaging. Transient hemodynamic effects were frequent: hypotension (54.5%), bradycardia (61.5%), asystole (33.3%), and syncope (33.3%). TIA occurred in 1 patient (1%), minor stroke in 1 (1%), and disabling stroke in 2 patients (2.1%). Mortality was 0%. Morbidity was 0% in cases done with distal protection. In conclusion, the authors summarize that CAS performed in patients with severe carotid stenosis and contralateral occlusion compared favorably with the results obtained with CEA, to the extent that if randomized series comparing CEA and CAS are done, stenting might be considered as the treatment of choice in this subgroup of patients.

In 2013, Mercado N. et al. [6] published in-hospital outcomes in patients with and without CCO who underwent elective CAS during carotid artery revascularization and endarterectomy (CARE Registry). Between 2005 and 2010, 8416 patients underwent elective CAS, of whom 900 (12%) had CCO. Patients with CCO were younger (69 vs 71 years, p<0.001), more likely to be male (68 vs 61%, p<0.001), more likely to have target lesion-related symptoms (46 vs 39%, p<0.001), prior neurologic impairment (56 vs 45%, p<0.001), and more likely to have target lesion restenosis after previous CAS (5 vs 3%, p<0.001). The primary composite endpoint occurred in 14 (1.6%) and 211 (2.8%) patients with and without CCO, respectively (adjusted OR=0.58, 95% CI [0.33–1.00], p=0.052). In this study, approximately 12% of CAS procedures were performed in CCO presence. There was no evidence that CCO was associated with an increased risk of in-hospital death, nonfatal MI, or stroke in patients after elective CAS.

Peker A. et al. (2016) [15] also retrospectively evaluated the medical records of 26 consecutive patients with CCO who underwent CAS performed by a single operator using the same procedural protocol (with distal protection and closed-cell stents). The median mRS score for the 26 patients was 1 (range 0-5) before and after CAS. All of the patients underwent clinical and imaging follow-up (mean 19.5 ± 14.3 and 11.6 ± 11.2 months, respectively). Thirty-day mortality/permanent morbidity rates were 0 %. One patient had hyperperfusion syndrome and was managed medically without sequelae; however, he had stent occlusion after 30 days, resulting in a decline in his mRS from 4 (preprocedure) to 5. Otherwise, there was no decline in mRS during the post-discharge follow-up. In conclusion, the authors summarize that, according to an independent analysis of this single-operator series, CAS is safe and effective for the treatment of patients with CCO.

In 2019, Cotter R. et al. [16] from the University of Colorado Denver Medical Center (Denver, CO) studied the association between contralateral carotid occlusion and the rate of subsequent target lesion restenosis and revascularization after carotid artery stenting based on the treatment outcomes of 267

patients. The mean age of the patients was 70 years. There was no statistically significant difference (p>0.05) in the indication for the procedure (asymptomatic or ischemic symptoms) or comorbidities between the groups. During 5 years of follow-up, the rate of duplex stenosis >80% was 6% in the non-CCO group and 9% in the CCO group (p=0.45). Despite similar rates of restenosis greater than 80%, there was a significant association between CCO and subsequent target lesion revascularization (TLR) with rates of 6.4 vs 0.9% at 5 years (OR = 7.2, CI [1.2–43], p = 0.04). There were no significant differences between the groups in the 5-year incidence of stroke (4.3% in the CCO group vs. 4.5% in the no-CCO group, OR=0.53, CI [0.07–4.22], p=1.0) or MACCE (15% vs. 18%, HR 0.55, CI 0.2–1.55, p=0.68). Based on the obtained results, it can be concluded that patients with CCO after CAS were more likely to undergo TLR during the long-term follow-up, but they did not have any differences in the success of the procedure or short-term and long-term outcomes.

Based on a meta-analysis and meta-regression analysis of 43 studies and 96,658 patients, Kokkinidis D.G. et al. [5] in 2020 studied the prognostic role of contralateral carotid occlusion in perioperative outcomes of patients after carotid endarterectomy compared with CAS. 43 studies (46 groups) were selected, including 96,658 patients (75,857 CEA and 20,801 CAS). The CCO group included 9258 patients. Carotid artery revascularization in patients with CCO was associated with an increased risk of 30-day mortality (OR=1.75, 95% CI [1.38–2.23], p<0.001; I2=0%), stroke (OR=1.77, 95% CI [1.41–2.22], p<0.001; I2=46%), TIA (OR=2.10, 95% CI [1.34–3.27], p=0.001; I2=15%), and the combined endpoint of stroke/death (OR=1.78, 95% CI [1.54–2.05], p<0.001; I2=0%). There was no difference in the risk of perioperative MI (OR=0.81, 95% CI [0.50–1.31], p=0.388; I2=0%). Subgroup analysis showed that CEA in patients with CCO was associated with an increased risk of stroke (OR=2.07, 95% CI [1.72–2.49], p<0.001; I2=14%), death (OR=1.80, 95% CI [1.55–2.10], p<0.001, I2=0%), TIA (OR=2.18, 95% CI [1.38–3.45], p<0.001; I2=13%), and stroke/death (OR=1.80, 95% CI [1.55–2.10], p<0.001, I2=0%); whereas the patients with CCO undergoing CAS had an increased risk of death (OR=1.65, 95% CI [1.07–2.60], p=0.023; I2=0%), but neither stroke (OR=0.94, 95% CI [0.61–1.47], p=0.080; I2=31%), nor TIA (OR=1.18, 95% CI [0.18–7.55], p=0.861; I2=43%). Meta-regression analysis did not find any significant association for any outcome, and there was no evidence of publication bias. Based on the obtained data, it can be concluded that the presence of CCO negatively affects the results of carotid artery revascularization. Patients with CCO have a significantly higher risk of periprocedural stroke, death, and TIA. CEA in patients with CCO is associated with an increased risk of periprocedural stroke, death, TIA, and death/stroke; whereas CAS in the presence of CCO is associated with an increased risk of periprocedural death, but neither stroke, nor TIA.

In 2021, Casana R. et al. [17] retrospectively evaluated 146 patients with and without CCO who underwent CAS procedure between 2010 and 2017 at a single institution. The primary objective of the study was to evaluate mortality and complications in the short term (defined as occurring during hospitalization and within 30 days) and after 3-year follow-up. The secondary objective of the study was to evaluate the rate of restenosis in the short- and long-term periods. The overall success rate of CAS was 99.3%, and the 30-day all-cause mortality was 0.7% (one death). Regarding complications, there were no major strokes in the CCO groups, while there was one (1.4%) stroke in the non-CCO group (P=1.00). The 30-day minor stroke rate was 1.4% (1 patient) in the CCO group, and 2.7% (2 patients) in the non-CCO group (P=1.00). During 3 years of follow-up, death occurred in 11 patients with CCO and 6 patients without CCO, respectively (15.1 vs. 8.2%, P=0.30). Major stroke occurred in 6 patients with CCO versus 2 patients without CCO (8.2 vs 2.7%, P=0.27); minor stroke in 6 patients with CCO versus 6 patients without CCO (8.2 vs 8.2%, P=1.0); and myocardial infarction in 6 patients with CCO (8.2%) and 3 patients without CCO (8.2 vs. 4.1%, P=0.49), respectively. Regarding the 30-day restenosis rate, it was observed in one patient (1.4%) in the CCO group, whereas there were no cases in the non-CCO group (P=1.00). During 3 years of follow-up, restenosis greater than 50% was observed in 7 patients (9.6%) in the CCO group and one patient (1.4%) in the non-CCO group (P=0.06), respectively. Kaplan-Meier survival analysis showed that patients with pre-existing CCO had a lower freedom from restenosis at 3 years compared with the non-CCO group (87.6 vs. 98.6%, P=0.024). The Cox regression model for 3-

year restenosis showed that female gender and hypertension were statistically significant predictors of restenosis. These results indicate that patients with pre-existing CCO did not have a significant increased risk of procedural adverse events after CAS in either the short- or long-term follow-up, but in the long term, they are more likely to develop restenosis, and CCO should always be considered as a clinical manifestation of more aggressive carotid atherosclerosis.

In 2022, Maeda Y. et al. [18] conducted a retrospective single-center study evaluating 218 patients with internal carotid artery stenosis who underwent CAS using dual protection (simultaneous flow reversal and distal filter) combined with blood aspiration. In this cohort, 5% of patients with internal carotid artery stenosis had contralateral carotid occlusion. There were no statistically significant differences in patient characteristics between the groups. The success rate of carotid artery stenting was 100%. There were no statistically significant differences in intraoperative complications, postoperative serious adverse events, or other outcomes between the two groups. These data suggest that dual-protection CAS combined with blood aspiration was safe and effective in preventing distal embolism in patients with internal carotid artery stenosis and contralateral carotid occlusion.

Liang Z. et al. [19] retrospectively analyzed and published in 2022 their 12-year experience of CAS in patients with CCO from 2010 to 2021. The study included 71 patients with CCO who underwent CAS. Of these, 61 patients (86%) were followed up for 9–134 months, with a mean follow-up of 63.3±30.4 months. In the perioperative period, 2 patients (2.8%) developed stroke, and one patient (1.4%) died of cerebral hemorrhage combined with cerebral herniation. During the follow-up, 2 patients (3.3%) developed stroke at 4 and 6 months after CAS, and 6 patients (9.8%) died (2 patients died of myocardial infarction, and 4 patients died of severe liver failure, motor vehicle accident, cervical fracture or unknown cause). Kaplan-Meier survival analysis showed that symptomatic carotid stenosis, age, stent type, and postdilatation were not associated with long-term stroke ($P<0.05$). These results allow us to conclude that CAS is a safe and effective surgical intervention in patients with CCO.

A number of randomized controlled trials have demonstrated the clinical equivalence of these types of carotid artery surgery.

In a study by Gavrilenko A.V. et al. (2018) [8], the treatment outcomes of 132 patients with ICA stenosis and contralateral occlusion were analyzed. The authors observed 2 fatal outcomes (3.23%) in the perioperative and early postoperative period due to developed MI in patients who underwent CEA. In the CEA group, 4 strokes (6.45%) occurred in the perioperative period. In the CAS group, 2 strokes (2.86%) were also noted in the perioperative period. It was established, that the risk factors for adverse events in patients of the CEA group were the presence of concomitant heart diseases, in the CAS group - a heterogeneous type of atherosclerotic plaque, its uneven surface and/or ulceration, as well as grade IV chronic cerebrovascular insufficiency.

In the CEA group, the incidence of MI was significantly higher in patients with FC III angina (n=17) than in patients with FC I-II angina (n=45): $\chi2=5.471$ ($p<0.05$). In the CAS group, MI was not observed in the preoperative and early postoperative periods. In conclusion, the authors note that the conducted analysis proves the importance of taking into account both functional, and anatomical and morphological characteristics, and that there are optimal conditions for each method.

DISCUSSION

This study shows that patients with CCO who underwent carotid revascularization have an increased risk of periprocedural stroke, TIA, and death overall. However, according to the world scientific literature, only patients with CCO who underwent CEA had an increased risk of stroke or TIA in the perioperative period compared to patients without CCO. No differences in the risk of periprocedural stroke were found among patients who underwent CAS.

These findings are consistent with randomized controlled trials, including NASCET and ACAS, which showed that the presence of CCO is a risk factor for 30-day mortality and other adverse cerebrovascular events in patients after CEA [13,14]. Other meta-analyses reported an increased risk of perioperative mortality and adverse neurological events in patients with CCO who underwent CEA [13–20].

Several hypotheses can be put forward to explain this well-established association. First, given that patients with CCO have bilateral carotid artery disease, the presence of CCO is a marker of exposure to multiple cardiovascular risk factors, and, consequently, more advanced atherosclerotic disease of the extracranial and intracranial vessels, including the vertebral arteries supplying the posterior brain. In addition, CEA involves intraoperative clamping of the internal carotid artery, which potentially contributes to decreased cerebral perfusion in the absence of adequate collateral pathways. Nevertheless, studies did not demonstrate a neurological benefit from bypass during CEA in patients with CCO [6,7,21]. On the other hand, no differences in perioperative stroke risk were found between patients with and without CCO who underwent CAS [17,18].

Patients with CCO have more comorbidities and extensive vascular pathology in other beds. Therefore, CCO may be a marker of increased overall procedural risk that is independent of the risk of stroke associated with CEA or CAS in the presence of CCO. Thus, such patients have an increased risk of developing post-procedural MI or other complications that may be fatal.

Selection of patients for carotid revascularization and the choice of the most appropriate revascularization method depend on comorbidities, symptoms, and anatomical features. The superiority of CAS over CEA in the treatment of symptomatic stenosis is well established, while most studies confirmed no difference between CAS and CEA in the treatment of asymptomatic stenosis.

CAS is the preferred method of revascularization in patients who are not candidates for surgical intervention or are at high risk. The results of several multicenter randomized trials, combined with the proven association between CCO and an increased risk of periprocedural stroke after CEA, strengthen the characterization of CCO as an anatomical marker associated with poor periprocedural neurological outcomes after CEA and, therefore, an indication for stenting.

Theoretically, CAS offers an advantage for patients with CCO. Cerebral embolic protection during stenting can be accomplished either by proximal balloon occlusion or by distal filters. Proximal protection devices perform their protective function by inhibiting blood flow proximal to the ICA lesion, while distal filters use a basket-like mesh distal to the lesion to prevent emboli from entering ipsilateral cerebral vessels.

Both methods are equivalent in terms of periprocedural stroke prevention in patients with CCO. However, the functional difference between proximal balloon occlusion and distal filter protection may have clinical implications for patients with CCO. On the one hand, the use of distal filters in patients with CCO allows for the provision of blood flow to the impaired cerebral circulation of these patients. On the other hand, it can be argued that proximal balloon occlusion devices act similarly to cross-clamping during CEA, so it seems reasonable to prefer distal protection during CAS in patients with CCO [5,18,19].

CONCLUSION

Our study confirms that the presence of contralateral carotid occlusion may be a marker of increased perioperative risk after carotid revascularization. Both carotid endarterectomy and carotid stenting are associated with increased 30-day mortality in patients with contralateral carotid occlusion. The results obtained in the studies demonstrating the superiority of carotid endarterectomy over carotid stenting in patients with contralateral carotid occlusion may be explained by the fact that these studies were conducted in surgical quality improvement registries, in which carotid stenting is often underrepresented compared to carotid endarterectomy. Furthermore, patients with contralateral carotid artery occlusion referred for carotid endarterectomy may have been an initially somatically healthier group than patients who underwent carotid artery stenting.

We believe that surgical intervention in patients with hemodynamically significant stenosis of the internal carotid artery and contralateral occlusion should be differentiated, and have an individual approach.

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