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Advantages of Endovascular Surgery in Carotid Atherosclerosis

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ABSTRACT

The article discusses the advantages of endovascular treatment of carotid artery atherosclerosis as an effective alternative to traditional carotid endarterectomy. Based on the results of the international ACST-2 study, comparable efficacy of carotid stenting and endarterectomy in preventing ischemic stroke and reducing mortality is demonstrated. Data on the clinical advantages of the endovascular approach, including a reduced risk of myocardial infarction, cranial nerve damage and a shorter rehabilitation period are presented. Particular attention is paid to the effectiveness of endovascular methods in complex anatomical variants of damage, in patients at high surgical risk and in multifocal atherosclerosis. Statistical data on the superiority of endovascular thrombectomy over drug therapy in acute ischemic stroke are provided, demonstrating a significant increase in the functional independence of patients and a decrease in mortality. Technological aspects of modern endovascular techniques providing effective revascularization with minimal trauma to the vascular wall are discussed. The materials of the article are of interest to vascular surgeons, endovascular specialists, neurologists and cardiologists dealing with problems of cerebrovascular pathology.

Keywords

Carotid atherosclerosis, carotid artery stenting, carotid endarterectomy, endovascular surgery, ischemic stroke.

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Introduction

Cardiovascular diseases remain the leading cause of mortality worldwide. Among the numerous risk factors contributing to these pathologies, the issue of multifocal atherosclerosis has become increasingly relevant. Modern medical practice demonstrates that a significant proportion of fatal outcomes in cardiology patients are associated with atherosclerotic lesions of the carotid arteries [1].

According to recent studies, stenosing atherosclerosis of the carotid arteries accounts for 9-40% of all ischemic strokes. Despite substantial progress in the pharmacological prevention of cerebrovascular complications, including the latest antiplatelet and lipid-lowering drugs, their effectiveness in high-risk patients remains insufficient. Of particular concern is the high probability of recurrent stroke, reaching 2-5% per year in asymptomatic carotid atherosclerosis and up to 12% in patients with a history of acute cerebrovascular accident. These findings justify the active implementation of surgical treatment methods, especially endovascular technologies, which offer an effective approach to correcting stenotic carotid artery lesions [2].

Метнор

In modern vascular surgery, two primary methods are actively used to correct atherosclerotic carotid artery stenosis: traditional carotid endarterectomy (CEA) and endovascular intervention in the form of carotid angioplasty with stenting (CAS). Classic CEA ensures the radical removal of atherosclerotic plaque and demonstrates a lower rate of perioperative cerebral complications within the 30-day observation period. However, this technique is associated with an increased risk of cardiac complications and peripheral nerve injury [3].

The endovascular approach using CAS is minimally invasive and is associated with a significantly lower incidence of myocardial infarction and access-related complications. However, current data indicate slightly higher rates of neurological complications and mortality compared to open surgery [4].

The optimal method for carotid artery revascularization should combine the clinical advantages of both approaches—ensuring effective removal of the atherosclerotic substrate with reliable cerebral protection while minimizing surgical trauma for the patient.

In the context of discussing the benefits of endovascular surgery for carotid atherosclerosis, special attention should be given to the ACST-2 (Second Asymptomatic Carotid Surgery Trial). This is the largest multicenter international randomized study to date comparing carotid stenting (CAS) and carotid endarterectomy (CEA) in patients with asymptomatic carotid artery stenosis [5].

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The study included 3,625 asymptomatic patients with significant carotid artery stenosis from 130 hospitals across 33 countries. Patients deemed suitable for both stenting (CAS) and endarterectomy (CEA) were randomized into two groups: 1,811 patients underwent CAS, and 1,814 underwent CEA. The average follow-up period was five years.

The ACST-2 results demonstrated that both procedures had similar risks and favorable outcomes. The procedural risk of disabling stroke or death was approximately 1% for each method, aligning with data from large representative registries. Notably, after successful completion of either procedure (CAS or CEA), the annual risk of disabling or fatal stroke was only about 0.5% for both interventions.

An analysis of non-fatal periprocedural events revealed that the risk of non-disabling procedural stroke was slightly higher with stenting than with endarterectomy. However, this was offset by a higher risk of myocardial infarction and cranial nerve injury in the endarterectomy group.

During long-term follow-up, no significant differences were found between the groups in terms of overall mortality (330 cases in the CAS group vs. 313 in the CEA group), stroke-related mortality (23 vs. 25 cases, respectively), or the incidence of non-procedural strokes (91 vs. 79 cases; hazard ratio 1.16, 95% CI 0.86– 1.57).

The study authors conclude that the choice between CAS and CEA can be based on the individual characteristics of the patient, physician preference, and available resources, as the long-term protective effects of both procedures appear to be similar. A key advantage of endovascular intervention is the lower risk of cranial nerve injury and myocardial infarction, which are more common in endarterectomy. Additionally, endovascular treatment may be preferable for patients with high surgical risk, anatomically challenging lesions, or certain comorbid conditions. This minimally invasive approach provides comparable stroke protection, a shorter recovery period, and potential quality-of-life benefits, making it an attractive alternative to traditional surgery for many patients with asymptomatic carotid artery stenosis.

The ACST-2 study has significantly expanded the evidence base compared to previous research, more than doubling the number of asymptomatic patients included in clinical trials comparing CAS and CEA. The results indicate that both procedures offer comparable stroke protection, at least in the first few years following intervention.

Confirming the equivalent efficacy of endovascular and open surgical procedures is particularly important, as minimally invasive interventions may have a decisive advantage in certain clinical situations. Endovascular surgery is especially valuable for patients with multifocal atherosclerosis, who are often

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denied open surgery due to the high risk of intra- and postoperative complications. As clinical practice shows, endovascular interventions are often the only life-saving treatment option for such patients [6].

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Statistical data confirm the superiority of endovascular thrombectomy over pharmacological therapy: functional independence at three months after the procedure is achieved in 44–45% of patients following endovascular treatment, compared to 17–18.9% in the medical therapy group (OR 2.67; 95% CI: 1.60– 4.48; p<0.001). Additionally, mortality is reduced from 20-26% to 14-16.8% (p=0.05), while the rate of hemorrhagic complications does not differ significantly (7% vs. 4%, p=0.75) [11].

Particularly impressive results have been observed with endovascular treatment of large vessel occlusions (internal carotid artery, M1 segment of the middle cerebral artery) within the first 24 hours: functional independence is achieved in 20% of cases, compared to 7% in the conservative therapy group (OR 2.97; 95% CI: 1.60-5.51).

Advancements in endovascular instrumentation have expanded the technical capabilities of the method, enabling revascularization of distal cerebral artery segments (M2-M4, A1-A2, P1-P3, and cerebellar arteries). The effectiveness of recanalization according to the TICI 2b-3 scale has reached impressive

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levels: 86% in all ischemic stroke patients and 76–88% in major clinical trials (DEFUSE 3, DAWN, SWIFT-PRIME) [12].

Alongside high recanalization efficacy, another key advantage of modern endovascular technologies is their safety and minimal invasiveness. Contemporary thrombectomy techniques allow for the removal of thrombotic material and the restoration of vessel patency with minimal damage to the vascular wall. This is particularly important in atherosclerotic vessels, where there is a high risk of plaque fragmentation and distal embolization. The use of specialized stent retrievers and aspiration systems ensures precise thrombus removal with minimal impact on surrounding structures [13].

Conclusions

A review of current data on the advantages of endovascular surgery for carotid artery atherosclerosis leads to several important conclusions. Endovascular treatment of stenotic carotid atherosclerosis, particularly carotid artery stenting (CAS), serves as an effective alternative to traditional open carotid endarterectomy (CEA). This is supported by the findings of the large-scale ACST-2 study, which demonstrated comparable long-term outcomes between the two techniques in terms of stroke prevention and mortality in patients with asymptomatic carotid stenosis.

The endovascular approach offers significant advantages, particularly for patients with high surgical risk, multifocal atherosclerosis, or complex vascular anatomy. The minimally invasive nature of the procedure, the elimination of the need for general anesthesia, and the reduced risk of cranial nerve injury and myocardial infarction make endovascular treatment especially valuable for select patient groups. Additionally, the shorter hospitalization and rehabilitation period associated with CAS significantly improves patients' quality of life.

Endovascular technologies are especially valuable in emergency situations. Endovascular thrombectomy (EVT) has demonstrated high efficacy in the treatment of acute ischemic stroke, significantly outperforming isolated pharmacological therapy. Statistical data provide compelling evidence of the benefits of endovascular intervention in terms of functional independence and reduced mortality. Moreover, the extension of the therapeutic window to 24 hours have been a groundbreaking advancement, particularly for patients who experience delays in seeking medical care.

Further advancements in endovascular technologies and materials, as well as the development of cerebral protection systems, will further improve treatment outcomes for patients with carotid atherosclerosis.

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