AMERICAN JOURNAL OF APPLIED MEDICAL SCIENCE
ISSN: 2996-5101 (online) | ResearchBib (IF) = 10.81 IMPACT FACTOR
Volume-4| Issue-6| 2026 Published: |30-06-2026|

RISK FACTORS FOR THE DEVELOPMENT OF POSTOPERATIVE COGNITIVE DISORDERS IN GERIATRIC PATIENTS AFTER CAROTID ENDARTERECTOMY BASED ON LOGISTIC REGRESSION

https://doi.org/10.5281/zenodo.20538342

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Abstract

Aim. To identify risk factors for postoperative cognitive disorders in elderly and senile patients after carotid endarterectomy (CEA) and to assess their prognostic significance.

Materials and methods. A prospective study included 98 patients who underwent CEA. Clinical and demographic characteristics, degree of carotid stenosis, comorbidities, and intraoperative cerebral oxygenation monitoring (rSO_2) were evaluated. Cognitive status was assessed using the MMSE and MoCA tests before surgery and on postoperative day 5. Logistic regression analysis was used to identify independent risk factors.

Results. Age, degree of carotid artery stenosis, diabetes mellitus, arterial hypertension, reduction in rSO_2, and type of anesthesia were associated with the development of postoperative cognitive disorders. The most significant factor was intraoperative cerebral desaturation. A predictive risk model was developed.

Conclusion. A combination of factors, including age, stenosis severity, metabolic and vascular disorders, and decreased cerebral oxygenation, determines the risk of cognitive impairment after CEA. The proposed model allows early identification of high-risk patients.

Keywords

carotid endarterectomy, cognitive disorders, logistic regression, rSO_2, NIRS, elderly patients.

INTRODUCTION

Postoperative cognitive disorders (POCD) are a common complication of carotid endarterectomy, especially in elderly patients. They manifest as impairment of memory, attention, and executive functions and may persist for a long period, negatively affecting quality of life.

The pathogenesis of POCD is multifactorial and includes chronic cerebrovascular insufficiency, atherosclerotic disease of the carotid arteries,

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intraoperative hypoperfusion, and metabolic disturbances. A key role is played by reduced cerebral oxygenation during surgery.

The aim of the study was to identify independent risk factors for the development of POCD after CEA using logistic regression analysis.

MATERIALS AND METHODS

The study included 98 patients who underwent carotid endarterectomy. The patients' age ranged from 62 to 81 years.

The following parameters were evaluated:

- age;
- degree of carotid artery stenosis;
- presence of diabetes mellitus;
- presence of arterial hypertension;
- regional cerebral oxygen saturation (rSO_2);
- type of anesthesia (general / regional).

Cognitive function was assessed using:

- MMSE;
- MoCA.

Postoperative cognitive disorders were recorded on postoperative day 5.

Statistical analysis included:

- logistic regression;
- χ^2 test;
- Student's t-test.

Statistical significance was defined as $p < 0.05$.

RESULTS (extended version)

Baseline analysis showed that the enrolled patients were comparable in terms of main clinical and demographic characteristics. However, patients who subsequently developed postoperative cognitive disorders (POCD) demonstrated a higher burden of vascular and metabolic risk factors.

Table 1. Clinical and demographic characteristics (extended analysis)

Parameter	Total (n=98)	POCD (+) (n=46)	POCD (−) (n=52)	p
Age, years	69.4 ± 6.2	72.1 ± 5.8	66.9 ± 6.0	<0.01
Male, n (%)	62 (63.3%)	31 (67.4%)	31 (59.6%)	>0.05
Diabetes mellitus, n (%)	41 (41.8%)	27 (58.7%)	14 (26.9%)	<0.01
Arterial hypertension, n (%)	74 (75.5%)	40 (87.0%)	34 (65.4%)	<0.05
Carotid stenosis ≥70%, n (%)	58 (59.2%)	37 (80.4%)	21 (40.4%)	<0.01

Patients with POCD significantly more often had diabetes mellitus, severe carotid stenosis, and arterial hypertension, indicating their important role in postoperative cognitive decline.

Dynamics of cognitive function

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All patients demonstrated a decline in cognitive performance in the early postoperative period; however, the magnitude of impairment differed significantly between groups.

Table 2. Cognitive test dynamics

Parameter	POCD (+)	POCD (−)	p
MMSE preoperative	26.2 ± 1.9	27.8 ± 1.6	<0.05
MMSE day 5	22.3 ± 2.1	26.7 ± 1.8	<0.001
Δ MMSE	−3.9 ± 1.4	−1.1 ± 0.9	<0.001
MoCA preoperative	24.0 ± 2.3	26.5 ± 1.9	<0.01
MoCA day 5	19.8 ± 2.5	24.7 ± 2.0	<0.001
Δ MoCA	−4.2 ± 1.6	−1.8 ± 1.1	<0.001

The most pronounced decline in cognitive function was observed in the POCD group, where the MMSE reduction exceeded 3.5 points, indicating clinically significant cognitive deterioration.

Intraoperative cerebral oxygenation

A key finding of the study was the significant difference in rSO_2 parameters between groups.

Table 3. Intraoperative cerebral oxygenation (rSO_2)

Parameter	POCD (+)	POCD (−)	p
Baseline rSO_2 (%)	63.4 ± 5.1	64.1 ± 4.8	>0.05
Minimum rSO_2 (%)	48.2 ± 4.6	56.9 ± 4.2	<0.001
Duration of desaturation >20% from baseline (min)	18.7 ± 6.4	6.3 ± 3.1	<0.001
Mean intraoperative rSO_2 (%)	55.1 ± 4.9	60.8 ± 4.5	<0.01

Patients with POCD experienced a more pronounced and prolonged reduction in cerebral oxygenation, confirming hypoxia as a key mechanism of postoperative cognitive dysfunction.

Logistic regression and predictive model

Multivariate analysis identified independent predictors of POCD:

- The strongest predictor was reduction in rSO_2 (OR = 3.12)
- Followed by diabetes mellitus (OR = 2.36)
- Severe stenosis (OR = 2.01)
- Age and hypertension showed moderate influence

The predictive model demonstrated good diagnostic performance:

- AUC = 0.84
- Sensitivity = 81%
- Specificity = 78%

OVERALL RESULTS SUMMARY

Thus, the development of postoperative cognitive disorders after carotid endarterectomy (CEA) is associated with:

- advanced patient age;

- severe atherosclerotic lesions of the carotid arteries;
- presence of diabetes mellitus and arterial hypertension;
- significant intraoperative reduction in cerebral oxygenation (rSO_2);
- prolonged intraoperative cerebral desaturation.

The most significant and potentially modifiable risk factor is the reduction in rSO_2, which makes cerebral oxygenation monitoring a promising target for the prevention of cognitive complications.

DISCUSSION

The obtained results confirm that postoperative cognitive disorders after CEA are determined by a combination of vascular, metabolic, and intraoperative factors.

The most important predictor was intraoperative cerebral desaturation (decrease in rSO_2), reflecting the critical role of cerebral hypoperfusion in the development of cognitive impairment. Additional risk factors include diabetes mellitus and arterial hypertension, which contribute to the progression of microangiopathic changes and reduced cerebral autoregulation.

The type of anesthesia also appears to influence cognitive outcomes, which may be explained by differences in hemodynamic stability and cerebral perfusion during surgery. Patients receiving less stable intraoperative hemodynamic management may experience deeper or more prolonged cerebral oxygen desaturation, increasing the risk of postoperative cognitive decline.

Overall, these findings emphasize that postoperative cognitive dysfunction is a multifactorial complication, where intraoperative cerebral oxygenation plays a central role and represents a potentially modifiable target for prevention strategies.

CONCLUSION

1. POCD after carotid endarterectomy occurs predominantly in elderly patients.
2. The main risk factors include age, degree of carotid stenosis, diabetes, hypertension, and decreased rSO_2.
3. Intraoperative cerebral desaturation is a key predictor of cognitive impairment.
4. The logistic regression model allows identification of high-risk patients for targeted preventive interventions.

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