INPLASY

Outcomes of perioperative silent brain infarction: a systematic review and meta-analysis

INPLASY202530021
doi: 10.37766/inplasy2025.3.0021
Received: 6 March 2025
Published: 6 March 2025

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ADMINISTRATIVE INFORMATION

Support - Nil.

Review Stage at time of this submission - Risk of bias assessment.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202530021

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 6 March 2025 and was last updated on 6 March 2025.

INTRODUCTION

Review question / Objective The aim of our meta-analysis was to determine the incidence of the above postoperative complications during hospitalization and at the longest follow-up among patients undergoing elective carotid surgery, stratified by the presence or absence of perioperative silent brain infarction.
(i) population: adult patients undergoing carotid artery surgery.
(ii) intervention (exposure): presence of perioperative silent brain infarction detected on MRI.
(iii) comparator: absence of perioperative silent brain infarction detected on MRI.
(iv) outcomes: mortality during hospitalization and at the longest follow-up, focal neurological deficit during hospitalization and at the longest follow-up, postoperative cognitive dysfunction.
(v) study design: prospective and retrospective observational studies, post-hoc analyses of RCTs, randomized and non-randomized controlled trials.

Rationale Carotid artery atherosclerosis is a prevalent vascular condition with an increasing incidence each year. In recent years, growing attention has been given to the issue of silent brain infarction (SBI) following elective surgical procedures. Current evidence indicates that the incidence of silent strokes during carotid artery surgery can reach 20%, ranging from 10% to 30%, depending on the surgical technique employed. However, contemporary clinical guidelines do not account for the likelihood of this complication when determining the appropriate type of surgical intervention. The limited focus on perioperative silent strokes is largely due to a lack of comprehensive data on their long-term outcomes. Therefore, this meta-analysis aimed to evaluate the incidence of postoperative complications both during hospitalization and at the longest available follow-up in patients undergoing elective carotid surgery, stratified by the presence or absence of perioperative silent brain infarction.

Condition being studied Perioperative silent brain infarction.

METHODS

Search strategy A systematic literature search of studies was conducted in PubMed (Medline), and the Cochrane Central Register of Controlled Trials (CENTRAL) by two independent investigators. Both backward and forward snowballing methods were also used for an exhaustive search (Litmaps service). Language or year restrictions were not applied.

Participant or population Adult patients following carotid artery surgery.

Intervention Presence of SBI associated with carotid artery surgery.

Comparator Absence of SBI associated with carotid artery surgery.

Study designs to be included Prospective and retrospective observational studies, RCTs, post-hoc analyses of RCTs and non-randomized interventional studies.

Eligibility criteria
Exclusion criteria:
1) no required outcome;
2) full-text version of the publication was not found;
3) failure to meet inclusion criteria;
4) duplicated data.

Information sources PubMed (Medline), Cochrane Central Register of Controlled Trials (CENTRAL), and databases from Litmaps service (Crossref, Semantic Scholar, OpenAlex).

Main outcome(s) The primary endpoint was the mortality rate at the longest follow-up.

Additional outcome(s) Mortality during hospitalization, focal neurological deficit during hospitalization and at the longest follow-up, postoperative cognitive dysfunction.

Data management The researchers developed a special data collection form. Two authors independently extracted data from full-text publications as well as supplemental or additional files from all included studies. The following data were collected: 1) general information: first author, year of publication, journal, country, funding sources, study design, and number of patients; 2) patient characteristics: age, sex, incidence of perioperative silent brain infarction and its assessment method, comorbidities, and chronic medication use; 3) surgical data: type of intervention (carotid artery stenting (CAS) or carotid endarterectomy (CEA)) and procedure duration, type of anesthesia, and shunt usage; 4) outcome data: incidence of focal neurological deficit during hospitalization and at the longest follow-up, incidence of postoperative cognitive dysfunction (POCD), and mortality both during hospitalization and at the longest follow-up.
For studies reporting continuous data in non-standard formats for meta-analysis (e.g., median, interquartile range (IQR), or range), we will use methods to estimate the mean and standard deviation (SD), as proposed by Luo et al. (2018), and Wan et al. (2014).

Quality assessment / Risk of bias analysis The internal validity and risk of bias will be assessed by two independent reviewers using the "Tool to assess risk of bias in cohort studies" contributed by the CLARITY Group at McMaster University.
Publication bias and small-study effects will be assessed using Egger's test and funnel plot analysis. The certainty of evidence will be assessed with the GRADE systematic approach.

Strategy of data synthesis We will use the Review Manager software (RevMan, version 5.4, The Cochrane Collaboration, 2020) and STATA (StataCorp LLC, version 18.0, Texas, USA) for data analysis and visualization. Odds ratio (OR) with 95% confidence intervals (CI) to compare outcomes between patients with identified perioperative silent brain infarction (SBI+) and those without perioperative silent brain infarction (SBI–) will be calculated. To assess outcome prevalence in the SBI+ and SBI– groups, we will compute pooled frequencies with 95% Jeffreys CI and back-transformed Freeman-Tukey proportions with 95% CI. Statistical significance for hypothesis testing will set at the 0.05 level.
We will assess statistical heterogeneity using the I-squared (I^2) statistic and the Cochrane Q test. The fixed-effects Mantel-Haenszel model will be applied in cases of low statistical heterogeneity (I^2 0.05), whereas the random-effects model (restricted maximum likelihood [REML]) will be applied when $I^2 \geq 50\%$ and/or $p < 0.05$.
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medication use; 3) surgical data: type of intervention (carotid artery stenting (CAS) or carotid endarterectomy (CEA)) and procedure duration, type of anesthesia, and shunt usage; 4) outcome data: incidence of focal neurological deficit during hospitalization and at the longest follow-up, incidence of postoperative cognitive dysfunction (POCD), and mortality both during hospitalization and at the longest follow-up.

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Subgroup analysis No subgroup analyses will be conducted.

Sensitivity analysis No sensitivity analysis will be conducted.

Language restriction No language limitations.

Country(ies) involved Russian Federation.

Keywords Silent brain infarction, covert stroke, carotid artery surgery, carotid artery stenting, carotid endarterectomy, mortality, POCD, focal neurological deficits.

Contributions of each author

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