

# Influence of Contralateral Carotid Occlusion on Outcomes After Carotid Endarterectomy: A Meta-Analysis

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**Background:** There is a controversy about whether the contralateral carotid occlusion (CO) in patients undergoing carotid endarterectomy (CEA) is associated with worse early and long-term outcomes. The aim of this systematic review and meta-analysis was to investigate the impact of CO on outcomes after CEA. **Methods:** PubMed, Embase, and MEDLINE databases were searched until January 2018 for studies comparing early and long-term outcomes of CEA in patients with CO and with patent contralateral carotid (CP). Two independent reviewers identified studies meeting our inclusion/exclusion criteria, extracted relevant data and assessed quality. Fixed- or random-effects models were used to calculate the overall effect estimates. **Results:** Our literature search identified 35 articles eligible for inclusion in the review and analysis. Patients with CO had higher rate of preoperative symptoms (Stroke + transient ischemic attack [TIA]) (odds ratio [OR] = 1.20, 95% confidence interval [CI]: 1.11-1.31) and had increased risk of perioperative neurological complications (Stroke + TIA) (OR = 1.63, 95% CI: 1.36-1.94) compared with those with CP. No significant difference in the perioperative mortality rate (OR = 1.40, 95% CI: .99-1.98) and the stroke-free survival rate at 5 years (OR = 1.06, 95% CI: .79-1.40) between 2 groups was identified. **Conclusions:** The presence of CO results in higher rate of preoperative symptoms and increases perioperative risk of neurological complications in CEA, but do not have a significant impact on the perioperative mortality rate and the stroke-free survival rate at 5 years. Careful consideration should be given in perioperative care in these patients

**Key Words:** Carotid endarterectomy—contralateral occlusion—stroke—meta-analysis.

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## Introduction

Carotid endarterectomy (CEA) was demonstrated as an effective intervention for stroke prevention in patients with significant carotid stenosis.<sup>1</sup> Among the factors that influence the incidence of postoperative neurological complications, the status of the contralateral carotid artery

(CCA) has always been studied as whether it was significant. Reports before 1986 suggest that CEA in patients with the contralateral carotid occlusion (CO) involves higher neurological morbidity.<sup>2</sup> In addition, data from both the Asymptomatic Carotid Atherosclerosis Study (ACAS)<sup>3</sup> and the North American Symptomatic Carotid Endarterectomy Trial<sup>4</sup> also suggest the CO is a predictor of poor outcomes following CEA.

However, most of the recent studies do not agree with these conclusions, reporting no early and long-term significant difference in patients with and without the CO.<sup>5</sup> So whether patients with the CO have a higher risk of postoperative stroke or stroke-related death than patients with the patent contralateral carotid (CP) remains a controversial issue. Considering each of these studies had relatively few patients with the CO in their surgical arms, it is necessary to perform comprehensive analysis by combining these studies. Therefore, we undertook a

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systematic review and the present meta-analysis to compare the early and long-term outcomes of CEA in patients with and without the CO in terms of relevant neurological complications, death, and stroke-free survival rate.

## Methods

### Search Strategy

PubMed, Embase, and MEDLINE were searched to identify eligible studies published from inception to January 2018 according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. Our search was restricted to studies published in English and the search terms were “contralateral,” “occlusion,” and “CEA.” Some studies were also identified by the references cited in selected articles and were then searched manually.

### Inclusion and Exclusion Criteria

Studies were included in the current meta-analysis if they met the following criteria: (1) retrospective clinical or cohort studies; (2) comparison of the outcomes between the CO and the CP; (3) with full-text available; and (4) irrespective of age, sex, and symptom. Cases were excluded from this study for the following reasons: (1) case reports; (2) review articles; (3) studies only reported as abstracts or with incomplete data; (4) comparison between CEA and carotid angioplasty and stenting (CAS); and (5) without comparison between the CO and the CP. If studies had overlapping subjects, only the study with the largest sample size was included in the final analysis.

### Quality Assessment

The methodological quality of studies was evaluated independently by 2 reviewers (H.J.L. and W.L.C.) with the Newcastle-Ottawa scale (NOS), which was used to assess the quality of nonrandomized studies.<sup>6</sup> The maximal score of NOS is 9 stars—4 stars for the selection process, 2 stars for comparability, and 3 stars for exposure/outcome—with a score  $\geq 5$  indicating high quality.

### Data Extraction

Two reviewers (W.L.C. and Y.L.H.) independently reviewed the articles and extracted the following data from all eligible publications: first author, year of publication, country, number of patients, use of shunt, preoperative symptoms, including stroke and transient ischemic attack (TIA), postoperative outcomes at 30 days including neurological complications (stroke + TIA) and death, and stroke-free survival rate at 5 years. Discrepancies between 2 reviewers were resolved by discussion or by a third person (H.J.L.).

### Statistical Analysis

Meta-analysis was performed with Review Manager Version 5.0 software (The Cochrane Collaboration, Oxford, United Kingdom). The estimated effect measures were odds ratio (OR) for dichotomous data and weighted mean difference for continuous data; both reported with 95% confidence intervals (CIs). All results were assessed for clinical and statistical heterogeneity. Heterogeneity was evaluated using  $\chi^2$  tests with significance set at  $P \geq .10$ , and  $I^2$  statistics were used for the evaluation of statistical heterogeneity ( $I^2 \geq 50\%$  indicating presence of significant heterogeneity). We used a fixed-effects model to synthesize data when heterogeneity was absent; otherwise a random-effects model was used. Subgroup analysis was conducted when clinical or methodological heterogeneity might exist. Data were presented as forest plots and the funnel plot was used to assess publication bias.  $P < .05$  was considered to be statistically significant.

## Results

### Search Results

A flow diagram of the data search and study selection process was summarized in Figure 1. There were 648 relevant articles found in our search after viewing the titles and abstracts. A total of 586 articles met exclusion criteria (15 reviews, 36 case reports, 133 duplicates, and 402 irrelevant). The remaining 62 articles were retrieved for full-text review. Finally, 35 articles were included in the present meta-analysis.<sup>3,5,7-39</sup>

### Study Characteristics

All included articles published from 1984 to 2018 were nonrandomized controlled trials. Most articles were from United States of America and Italy. A total of 4325 patients underwent CEA with the CO and 42,971 with the CP. Most

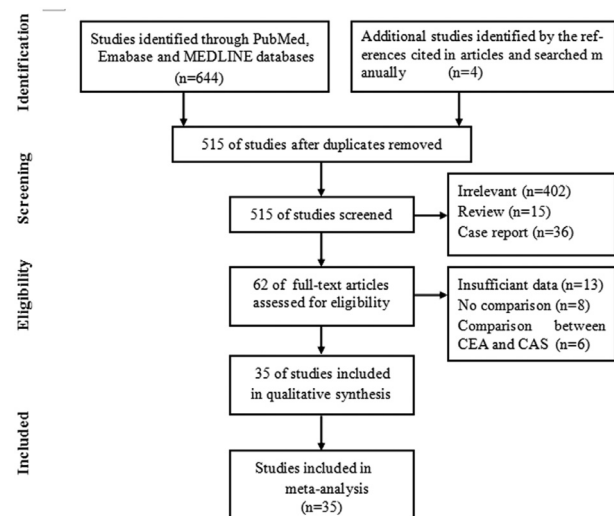


Figure 1. Flow diagram of identifying the studies in the meta-analysis.

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