Transcarotid versus transfemoral access for cerebrovascular intervention: protocol for a systematic review and meta-analysis

ABSTRACT

Introduction Cerebrovascular intervention is an excellent option to treat cerebrovascular diseases. Interventional access is a prerequisite and a foundation for cerebrovascular intervention, which is crucial to the success of an intervention. Although transfemoral arterial access (TFA) has become a popular and acceptable method of access for cerebrovascular angiography and intervention in clinical practice, it has some drawbacks that limit the usage in cerebrovascular interventions. Therefore, transcarotid arterial access (TCA) has been developed in cerebrovascular interventions. We aim to conduct a systematic review to compare the safety and efficacy of TCA with TFA for cerebrovascular intervention.

Methods and analysis In this protocol, Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols were followed. PubMed, Embase, Web of Science and the Cochrane Central Register of Controlled Trials will be searched mainly from 1 January 2004, to the formal search date. Additionally, reference lists and clinical trial registries will be searched. We will include clinical trials with more than 30 participants, which reported the endpoints of stroke, death and myocardial infarction. Two investigators will independently select studies, extract data and assess bias risk. A standardised mean difference with 95% CI will be presented for continuous data, and a risk ratio with 95% CI will be presented for dichotomous data. On inclusion of sufficient studies, subgroup analysis and sensitivity analysis will be conducted. The funnel plot and Egger’s test will be used to assess publication bias.

Ethics and dissemination As only published sources will be used in this review, ethical approval is not required. We will publish the results in a peer-reviewed journal.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- We will synthesise comprehensive evidence from more than 30 clinical trials in this systematic review and meta-analysis.
- The Cochrane Collaboration criteria will be used to assess the risk of bias.
- We will explore heterogeneity sources using subgroups and sensitivity analyses.

BACKGROUND

Cerebrovascular diseases, such as carotid artery stenosis, intracranial artery stenosis, aneurysms and malformations, cause severe long-term disability and death worldwide and negatively impact both public health and the economy.1 Cerebrovascular intervention is an excellent option to treat these diseases. In comparison to traditional open surgery, cerebrovascular intervention offers several advantages, including minimally invasive surgery, a wide range of indications, a shorter procedure time and reduced complications.2 With the advancement of continuous innovations in concepts, techniques and equipment, cerebrovascular intervention has become increasingly available in recent years.3 4

Interventional access is a prerequisite and a foundation for cerebrovascular intervention, which is crucial to the success of an intervention.5 Obtaining interventional access, therefore, is both critical and challenging. Transfemoral arterial access (TFA), introduced at the end of the 20th century for percutaneous coronary intervention, has become a popular and acceptable method of access for cerebrovascular angiography and intervention in clinical practice because it offers the advantages of being paid, technical simplicity, relatively painless and the ability to use larger catheters and equipment by clinicians.6 While TFA has been used with success for many years, it has some drawbacks including poor patient satisfaction, vascular complications, as well as some contraindications, such as peripheral vascular disease, femoral hernia and saddle embolism.7–12

Additionally, anatomic variants of the carotid artery or aortic arch prevent the
establishment of stable vascular access. Several factors have been identified as contributing to the difficulty of establishing TFA including aortic arch morphology that is unfavourable, extreme tortuosity of the common carotid artery, narrowing of the opening of the carotid artery and severe calcification of the aorta. As a result, transcarotid arterial access (TCA) has been developed to increase the safety and efficacy of cerebrovascular interventions. The procedure is accompanied by a dynamic flow reversal system that is designed to prevent embolism and perioperative embolic stroke in the patient. As compared with TFA, TCA eliminates the need to traverse the aortic arch, reduces the production of debris and the risk of atheroembolisation, and takes a shorter procedure period. It has been shown in numerous clinical trials that TCA has a lower stroke rate. Despite this, the benefits and risks of TCA compared with TFA are unclear, and there is no guideline that assists clinicians in making the right choice. The purpose of this study is to compare the safety and efficacy of TCA versus TFA for cerebrovascular interventions.

Objective
We aim to assess the safety and efficacy of TCA compared with TFA in people undergoing cerebrovascular intervention. The primary outcome is the rates of composite endpoints within 30 days and 1 year. Composite endpoints include death, stroke and myocardial infarction (MI). The secondary outcomes include procedural times, length of hospital stay, total radiation dose, and the rates of death, stroke, MI, cranial nerve injury (CNI), transient ischaemic attack (TIA) and other local and systemic complications.

METHODS AND ANALYSIS
The Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) were followed during the development of this protocol (see online supplemental 1, PRISMA-P checklist). We have prospectively recorded this systematic review on the PROSPERO database. We will promptly update on the PROSPERO registration if we do revisions to this protocol, and we will timely update the entire review process. We will conduct and report our systematic review following the Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension statement.

Patients and public involvement
Neither patients nor members of the general public are involved in this study.

Criteria for considering studies for this review
Types of studies
We will include randomized controlled trials (RCTs), a means of testing the effectiveness of a therapy or drug in health care, quasi-RCTs and prospective or retrospective case–control studies comparing TCA with TFA with more than 30 participants of each arm. In vitro studies, animal research, case series, case reports, and registry studies will be excluded. We will also exclude duplicate publications. The study selection will be limited to English-language publications. No limit will be placed on publication status.

Types of participants
Adults (≥18 years old) undergoing cerebrovascular intervention for ischaemic and haemorrhagic cerebrovascular diseases. Ischaemic cerebrovascular diseases will be focused on cerebrovascular stenosis caused by atherosclerosis in extracranial and intracranial arteries. For example, adult patients with symptomatic or asymptomatic carotid artery stenosis (>50% for symptomatic and >70% for asymptomatic patients according to the North American Symptomatic Carotid Endarterectomy Trial criteria) will be included in the study. Haemorrhagic cerebrovascular diseases will be focused on intracranial artery aneurysms and malformations. There will be no gender restrictions.

Types of interventions
TCA for cerebrovascular intervention is the experimental intervention and TFA is the comparator. Cerebrovascular intervention includes mechanical thrombectomy, stenting, drug delivery, etc. Trials compared TCA with TFA for cerebrovascular intervention will be considered for the analysis.

Types of outcome measures
Inclusion will be restricted to studies reporting at least one of these outcomes.

Primary outcomes
1. The rates of composite endpoints within 30 days after surgery.
2. The rates of composite endpoints within 1 year after surgery.

Second outcomes
1. Procedural time.
2. Length of hospital stay.
3. Total radiation dose.
4. The rates of death, stroke, MI, CNI, TIA and other local and systemic complications within 30 days and 1 year after surgery.
5. The non-neurological complications such as bleeding at puncture site, subcutaneous haematoma and pseudoaneurysm.

Search methods for identification of studies
Searches will be conducted in PubMed, Embase, Web of Science and the Cochrane Central Register of Controlled Trials. Using the Peer Review of Electronic Search Strategies Checklist, an experienced librarian developed the search strategy for PubMed and another librarian revised it (see online supplemental 2, search strategy).
Additionally, grey literature, conference proceedings, WHO International Clinical Trials Registry Platform, ClinicalTrials.gov, and the reference and citation list of relevant published systematic reviews and included studies will also be searched for relevant studies. If additional information is needed, we will contact the corresponding authors. Only English-language studies published after 1 January 2004 will be included in the search. Publication status will not be restricted.

Data extraction and analysis

Study selection

A two-tiered screening and selection process will be conducted independently by two reviewers. At first, two reviewers will evaluate the searched studies based on their title and abstract, with the eligible studies advancing to a second level of screening. Subsequently, in level two screening, full texts of retained articles will be obtained and referred to screen articles meeting the eligibility criteria, and the retained studies will be included for follow-up analysis. It will be considered the study with the largest sample size or the most direct interventions when data from different publications come from the same study series or study population. If there are discrepancies, we will resolve them through discussion or involve a third reviewer. Furthermore, for each screening level, a pilot test will be conducted using predesigned test forms to determine inter-rater reliability, and 80% agreement is required for formal screening (see online supplemental 3, screening pilot-test form). When additional information is required, the corresponding authors will be contacted.

Data extraction and management

A predesigned data extraction form will be used by two independent reviewers to extract data from eligible studies. Discrepancies will be discussed or referred to a third reviewer. When clinical trials with multiple arms are included, only the appropriate arms with more than 30 participants will be included. We will extract the following information for every eligible study: trial name, authors, publication date, study design, intervention approach, number of patients, outcome data (follow-up period, rates of composite endpoints within 30 days and 1 year after surgery, procedural times, length of hospital stay, total radiation dose, and rates of death, stroke, MI, CNI, TIA and other local and systemic complications), procedural success rate (defined by trials), characteristics of participants (eg, median age, male to female ratio, specific diseases, baseline blood pressure, drinking and smoking status, medical history). The inter-rater reliability should also be calculated using a similar pilot test in order to confirm that two reviewers have achieved a high level of agreement (80%). Additional information will be sought from the corresponding author if needed.

Assessment of risk of bias in included studies

An assessment of risk in eligible RCTs will be conducted by two reviewers using the Cochrane Collaboration tool.

The Newcastle-Ottawa Scale (see online supplemental 4, Newcastle-Ottawa Scale) will be applied to assess case-control studies. There will be a third investigator involved if there is any disagreement.

Measure of treatment effect

A mean difference will be used for continuous variables with 95% CIs for outcomes of the same scale, and a standardised mean difference will be used for outcomes of different scales. The risk ratio for dichotomous data will be calculated with a 95% CI.

Dealing with missing data

If necessary data or additional information are missing, the corresponding authors will be contacted. When missing data is not available, they will be imputed based on established methodologies, such as informative missingness difference of means when continuous outcomes are not available. Additionally, to ensure that our imputations do not affect the results, we will conduct a sensitivity analysis.

Data synthesis and statistical analysis

Data synthesis

When the data is insufficient or quantitative synthesis is not applicable, the findings will be reported narratively. A meta-analysis will be conducted whenever it is feasible to do a quantitative analysis with STATA (V.17, StataCorp, 2021). First, data from RCTs, then data from quasi-RCTs, and finally data from case-control studies will be included. To calculate the pooled estimates of safety and efficacy, a random-effects model will be used if the p value <0.10 or I² >50%, which indicates significant heterogeneity. Additionally, for identifying the source of heterogeneity, we will conduct a subgroup analysis and sensitivity analysis. The Mantel-Haenszel fixed-effect model is used to calculate the pooled estimates of safety and efficacy if p value ≥0.10 or I² ≤50%.

Assessment of heterogeneity

In order to determine whether methodological heterogeneity exists, the Q test will be applied to calculate the I² statistics. We will apply a random-effects model if the p value <0.10 or I² >50%, which indicates significant heterogeneity. Additionally, for identifying the source of heterogeneity, a subgroup analysis and sensitivity analysis will be conducted. The Mantel-Haenszel fixed-effect model is used to calculate the pooled estimates of safety and efficacy if p value ≥0.10 or I² ≤50%.

Subgroup analysis and sensitivity analysis

A subgroup analysis will be conducted if sufficient data are available for the purpose of exploring sources of heterogeneity, such as:

1. Gender (men and women).
2. Age (elderly vs young (80 years old as the cut-off)).
3. Types of diseases, such as acute stroke, subacute stroke versus chronic stroke; or ischaemic stroke versus haemorrhage stroke; or asymptomatic versus symptomatic carotid artery stenosis; or extracranial artery diseases versus intracranial artery diseases, if available. Acute stroke was defined as the course of a stroke within 14 days of onset, subacute stroke as the course of a stroke within 14–180 days of onset and chronic stroke as the course of a stroke after 180 days of onset.
Our findings will be tested for robustness through sensitivity analyses. For meta-analysis, we will collect only data from RCTs, quasi-RCTs and case-control studies and exclude each study individually. Then a comparison of the consistency of the results will be conducted.

Assessment of report bias

When there are 10 or more studies, a funnel plot analysis will be used to investigate publication bias. When the funnel plot exhibits asymmetry, Begg’s rank correlation and Egger’s weighted regression tests need to be performed.

Assessment of the certainty of the evidence

Evaluation of evidence’s quality will be performed using the Grading of Recommendation, Assessment, Development and Evaluation approach. There will be four levels of evidence strength: high, moderate, low or very low, depending on the risk of bias, consistency, directness, precision and publication bias. The results will be presented in the narrative form if a meta-analysis is not possible.

Author affiliations

1Department of Neurosurgery, Xuanwu Hospital, Capital Medical University, Beijing, China
2China International Neuroscience Institute (China-INI), Beijing, China
3Peking Union Medical College and Chinese Academy of Medical Sciences, Beijing, China
4Department of Neurology, Tianjin Baohi Hospital, Tianjin, China
5Health Science Center, Xi’an Jiaotong University, Shaanxi, China
6Medical Library, Xuanwu Hospital, Capital Medical University, Beijing, China
7Department of Interventional Radiology, Xuanwu Hospital, Capital Medical University, Beijing, China

Contributors

YC developed the initial idea for this study. JL and WL contributed to the original draft. DL and XW developed and revised the search strategy. ZK, TW, WX, RX, JW and HG will screen the potential studies independently, extract data from the included studies, assess the risk of bias and complete the data synthesis. BY, YM and LJ will arbitrate in cases of disagreement and ensure the absence of errors. JL, WL and DL contributed equally to this article. All authors reviewed and approved the publication of the protocol.

Funding

This study was supported by the Beijing Science and Technologic Project (Z201100005520019). The funder of the study had no role in study design, data acquisition, data analysis, data interpretation and manuscript writing.

Competing interests

None declared.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication

Not applicable.

Provenance and peer review

Not commissioned; externally peer reviewed.

Supplemental material

This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access

This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: http://creativecommons.org/licenses/by-nc/4.0/.

ORCID iDs

Wanying Liao http://orcid.org/0000-0001-7065-2387
Zixuan Xing http://orcid.org/0000-0001-7935-2575
Tao Wang http://orcid.org/0000-0003-1225-1733
Haizhi Gong http://orcid.org/0000-0003-1910-227X
Liqun Jiao http://orcid.org/0000-0003-4982-6295

REFERENCES


