

REVIEW

Open Access



Antiplatelets or anticoagulants? Secondary prevention in cervical artery dissection: an updated meta-analysis

Ei Zune The^{1,2,3*} , Ne Naing Lin⁴, Ching Jocelyn Chan⁵, Jason Cher Wei Loon⁵, Benjamin Yong-Qiang Tan¹, Chee Seong Raymond Seet¹, Hock Luen Teoh¹, Joy Vijayan¹ and Leong Litt Leonard Yeo¹

Abstract

Background: Extracranial artery dissection involving either internal carotid artery or vertebral artery is a major cause of stroke in adults under 50 years of age. There is no conclusive evidence whether antiplatelets or anticoagulants are better suited in the treatment of extracranial artery dissection.

Objectives: To determine whether antiplatelets or anticoagulants have advantage over the other in the treatment of extracranial artery dissection for secondary prevention of recurrent ischemic events or death.

Methods: Present meta-analysis followed Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 statement. Database search was done in Medline, Cochrane Central Register of Controlled Trials (CENTRAL) and ClinicalTrials.gov from inception to May 2021 using pre-defined search strategy. Additional studies were identified from reference lists from included studies, reviews and previous meta-analyses. Outcome measures were ischaemic stroke, ischaemic stroke or transient ischaemic attack (TIA), and death.

Results: Two RCTs and 64 observational studies were included in the meta-analysis. While the outcome measures of stroke, stroke or TIA and death were numerically higher with antiplatelet use, there were no statistically significant differences between antiplatelets and anticoagulants.

Conclusion: We found no significant difference between antiplatelet and anticoagulation treatment after extracranial artery dissection. The choice of treatment should be tailored to individual cases.

Keywords: Internal carotid artery, Vertebral artery, Extracranial artery dissection, Aspirin, Anticoagulants, Secondary prevention, Meta-analysis, Stroke

Background

Cervical artery dissection is an important cause of stroke in patients under 50 years of age [1, 2]. It involves dissection of either internal carotid artery or vertebral artery or both and can be unilateral or bilateral or multi-vessel [3]. It is estimated to affect 2.6 to 2.9 per 100,000 individuals per year [4]. While it can resolve spontaneously within 3

to 6 months, it can recur in a minority of individuals and mortality has been reported up to 5% of the affected individuals [4].

In severe cases, especially in multi-vessel dissections, interventional treatment with stenting may be needed. Conversely, in milder cases, conservative treatment with medication and regular follow-up till spontaneous resolution is indicated [5]. However, the choice of medication, in the form of antiplatelet or anticoagulant agents, is still largely dependent on the treating physicians' preference and evidence to support one treatment over the other

*Correspondence: eizune.the@nhs.net

³ Leicester General Hospital, Gwendolen Rd, Leicester LE5 4PW, UK
Full list of author information is available at the end of the article



© The Author(s) 2022. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

is lacking. Recent randomized controlled trials (RCT) have been limited in sample size [6, 7] and meta-analyses aggregating the data have not been conclusive [8–13].

It is the aim of the present study to include recent clinical trials to update the data and determine whether antiplatelets or anticoagulants have advantage over the other in the treatment of extracranial artery dissection for the secondary prevention of ischaemic events or death.

Methods

Present meta-analysis followed Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) 2020 guidelines [14].

Data search

An electronic database search was made in MEDLINE database and CENTRAL and ClinicalTrials.gov from inception to May 2021. The search words used and the steps involved for MEDLINE database search is shown in table S1 [Please see the details in Additional file 1] and it was adapted for searches in CENTRAL and ClinicalTrials.gov. Titles and abstracts from search results were scrutinized to determine the eligibility of a result to be included in the analysis. Additional search was made by reviewing references from previous meta-analyses and review papers. Subsequently, selected studies were then read in details for data extraction.

Screening, study selection and data extraction were done by a team of two investigators (CJC and JCWL) and independently reviewed by another team of two investigators (EZT and NNL). Any disagreement on

study inclusion and data extraction were resolved by discussion. Summary of methods involved is shown in Table 1.

Inclusion and exclusion criteria

Studies are included in the analysis if it fulfills following inclusion criteria—1. The study must provide evidence of dissection by either magnetic resonance imaging (MRI) or magnetic resonance angiography or computed tomography (CT) angiography or digital subtraction angiography. 2. The outcome data allows comparison between patients on antiplatelets and anticoagulants. A study is excluded—1. If there are four or less cases, 2. If cases with severe traumatic causes of arterial dissections, for example, motor vehicle collision, could not be excluded. Dissection associated with minor trauma, for example, recreational activities or sport related minor injuries are allowed to be included in the meta-analysis. 3. If concurrent intracranial dissection could not be excluded, 4. If cases treated with stents or surgical repairs as first treatment could not be excluded, and 5. If the study population comprises of children.

Outcome measures

Outcome measures for analysis include death related to carotid or vertebral artery dissection, ischaemic stroke and a composite outcome of stroke or TIA. If a study is to be included in the analysis, it must report at least one of the outcome measures.

Table 1 PICO's framework and applied inclusion and exclusion criteria

PICOs	Inclusion Criteria	Exclusion Criteria
Population	Adults with extracranial internal carotid or vertebral artery dissections (spontaneous or due to recreational activities or sport related minor injuries)	Cases with severe traumatic causes of arterial dissections Intracranial dissections Children
Intervention vs Comparison	Antiplatelet treatment (single or dual) including aspirin, indobufen, dipyridamole, ticlopidine, clopidogrel, sulfapyrazone Anticoagulant treatment (traditional or newer agents) including heparin, coumarin, warfarin, dabigatran, rivaroxaban, apixaban	Stents or Surgical repairs as first treatment
Outcome	Ischaemic stroke Ischaemic stroke or TIA Death	
Study design	Randomized controlled trials (RCT) Controlled clinical trials (CCT) Non-randomized studies including observational studies and cases series Must provide evidence of dissection Outcome data allows comparison between antiplatelets and anticoagulants Databases: Medline, CENTRAL, ClinicalTrials.gov Search period: Inception to May 2021	Systematic review Meta-analysis Case overlaps Less than five cases

PICOs = Population, Intervention, Comparison, Outcome and study design, TIA = transient ischaemic attack, CENTRAL = Cochrane Central Register of Controlled Trials
The above table (Table 1) with its legend should appear at the end of the Data Search sub-section and before Inclusion and Exclusion Criteria sub-section under METHODS section

Data extraction

Patients with surgical treatment or switching from one treatment group to another or receiving both antiplatelets and anticoagulants were excluded. In circumstances of studies with overlapping populations, the study with the most complete data or larger sample population was selected. Patients were grouped as either receiving antiplatelet or anticoagulation, most times using vitamin-K-antagonists, depending on the initial treatment they received. In cases with initial treatment with heparin, it is classified as in anticoagulant group if it is prolonged and used anticoagulation dose and it is classified as in antiplatelet group if it is given only for the initial days before transitioning to antiplatelet treatment. Data extraction was done with the aim to get as much complete data as possible, i.e. per-protocol data as much as possible.

Data analysis

Data analyses were done using Review Manager (version 5.4) developed by The Cochrane Collaboration [15]. Risk difference (RD) with 95% confidence interval (95% CI) was used since it was expected that there will be zero outcome events and Odd Ratio (OR) or Risk Ratio (RR) could not be calculated for each study before pooling the data in the meta-analysis. Nevertheless, ORs based on total population and outcome events were calculated for each outcome measure.

Results

The database and registries searches were done on 22nd June 2021 and the search was limited to end of May 2021 from the inception of the database and the registries. The search identified 3402 results after removing duplicates. After initial screening of titles and abstracts, 336 articles were selected for full reading. Subsequently, 286 articles were excluded with reasons of less than 5 cases (139), study population being children (6), review articles (25), treatment comparison not possible (63), severe traumatic cases and intracranial dissections could not be excluded (24), population overlaps (15) and article not available (14). As a result, 50 articles were available to be included in the analysis [6, 7, 11, 16–62]. Additional searches done from the reference list of the included articles identified a further 16 articles and were added to the analysis [63–78]. The steps involved in article selection process is shown in Fig. 1.

There are only two RCTs [6, 7]—Cervical Artery Dissection in Stroke Study (CADISS) and Biomarkers and Antithrombotic Treatment in Cervical Artery Dissection (TREAT-CAD) – and the rest is made up of mostly observation studies in the form of case reports, case series, and diagnostic studies. There are 25 studies

[16–19, 21–24, 27, 31, 32, 35, 46, 47, 50, 61, 63–69, 71, 73] reporting outcomes on internal carotid artery dissection only, 13 studies [20, 26, 28–30, 33, 34, 42, 52, 56, 57, 62, 70] reporting outcomes on vertebral artery dissection only and 28 studies [6, 7, 11, 25, 36–41, 43–45, 48, 49, 51, 53–55, 58–60, 72, 74–78] reporting outcomes on both. There were two studies [41, 52] with overlapping cases of vertebral artery dissection and data is taken from the study [52] published later in time. And the data on carotid artery dissection is taken from the other study [41] published earlier in time since it included both types of dissections. The follow-up period in each studies varies from less than 1 month to more than 3 months: 49 studies [6, 7, 11, 17–20, 22, 24, 25, 27, 29–31, 33–35, 38–52, 54, 57, 59, 63–66, 68–70, 72–78] with follow-up period of 3 or more months and 17 studies [16, 21, 23, 26, 28, 32, 36, 37, 53, 55, 56, 58, 60–62, 67, 71] with follow-up period of less than 3 months.

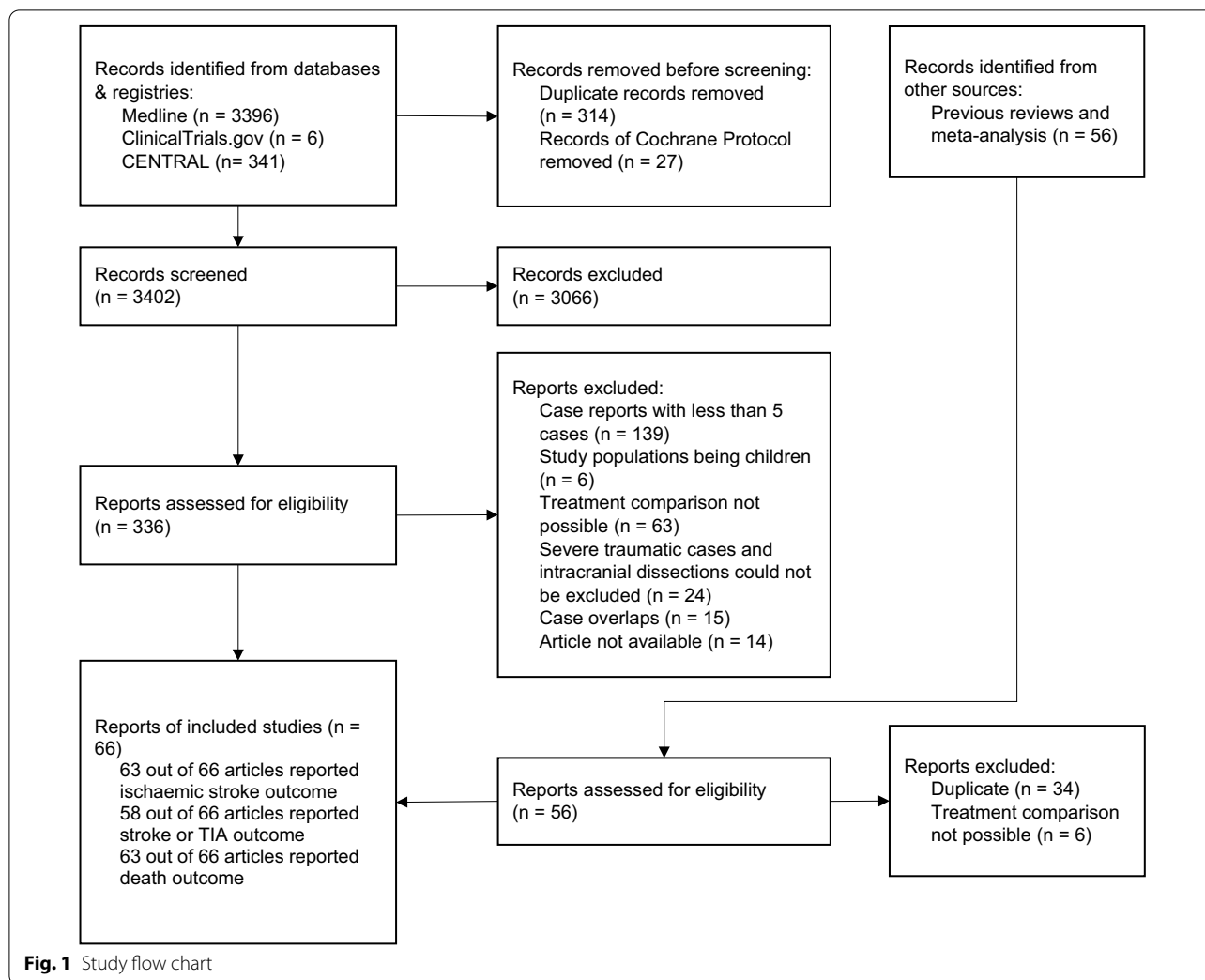
For CADISS RCT, data is taken from the results [10] published in 2015 and not the results [79] published in 2019. The reason for this is that there are many individuals who are not still on the initial treatment given at the start of randomization and it could not be certain that the effects of that treatment continue to exist. In TREAT-CAD RCT, there are clinical outcomes as well as MRI surrogate findings [11] and the MRI findings of acute ischaemic lesions without clinical symptoms have been taken as ischaemic stroke.

Ischaemic stroke

There are 63 studies included in the analysis for the outcome of ischaemic stroke [6, 7, 11, 16–36, 38–50, 52–77]. There are 3418 individuals in total and 1119 individuals received antiplatelets and 2299 individual received anticoagulants. There are 43 (3.84%) and 60 (2.61%) ischaemic stroke outcomes in antiplatelet group and anticoagulant group, respectively (OR 1.49). The risk difference was not statistically significant (0.00 [–0.01, 0.01], $p=0.77$). Random effect model was used and there was no significant heterogeneity ($I^2=0\%$, $p=1.00$) (Fig. 2).

Stroke or TIA

There are 58 studies included in the analysis for the outcome of stroke or TIA [6, 7, 11, 16–20, 22, 24–36, 38–40, 42–48, 50, 51, 53, 55–59, 61–78]. There are 2961 individuals in total and 1007 individuals received antiplatelets and 1954 individual received anticoagulants. There are 79 (7.85%) and 91 (4.66%) stroke or TIA outcomes in antiplatelet group and anticoagulant group, respectively (OR 1.74). The risk difference was not statistically significant (0.00 [–0.02, 0.02], $p=0.82$). Random effect model was used and there was no significant heterogeneity ($I^2=8\%$, $p=0.30$) (Fig. 3).



Death

There are 63 studies included in the analysis for the death outcome [6, 7, 11, 16–44, 46–53, 55–58, 60–78]. There are 3128 individuals in total and 989 individuals received antiplatelets and 2139 individuals received anticoagulants. There are 8 (0.81%) and 17 (0.79%) deaths in antiplatelet group and anticoagulant group, respectively (OR 1.02). The risk difference was not statistically significant (0.00 [−0.01, 0.01], $p=0.84$). Random effect model was used and there was no significant heterogeneity ($I^2=0\%$, $p=1.00$) (Fig. 4).

Subgroup with RCT data alone

Analyses with data from the only two RCTs on this topic were performed. For ischaemic stroke outcome, there are higher numbers of ischaemic stroke events in antiplatelet group compared to anticoagulant group (7.81% vs. 4.49%, respectively; OR 1.80, $p=0.20$), but this did not reach significance (Fig. 5). Similarly, for the combined stroke

and TIA outcome, there are higher number of events in antiplatelet group than in anticoagulant group (8.85% vs. 7.30%, respectively; OR 1.23, $p=0.65$) but this did not reach significance (Fig. 6). No deaths were reported in both RCTs.

Subgroup analyses with carotid artery or vertebral artery dissection alone

Analyses with data on carotid artery dissection alone and vertebral artery dissection alone were performed as well. There are no risk difference to minimal risk difference with no statistical significance in the analyses for carotid artery dissection alone: in favour of antiplatelet treatment for ischaemic stroke outcome (total 1403 subjects in 36 studies; -0.01 [−0.02, 0.01], $p=0.52$), no risk difference for ischaemic stroke or TIA outcome (total 1030 subjects in 29 studies; 0.00 [−0.05, 0.05], $p=0.93$), and no risk difference for death outcome (total 1347 subjects

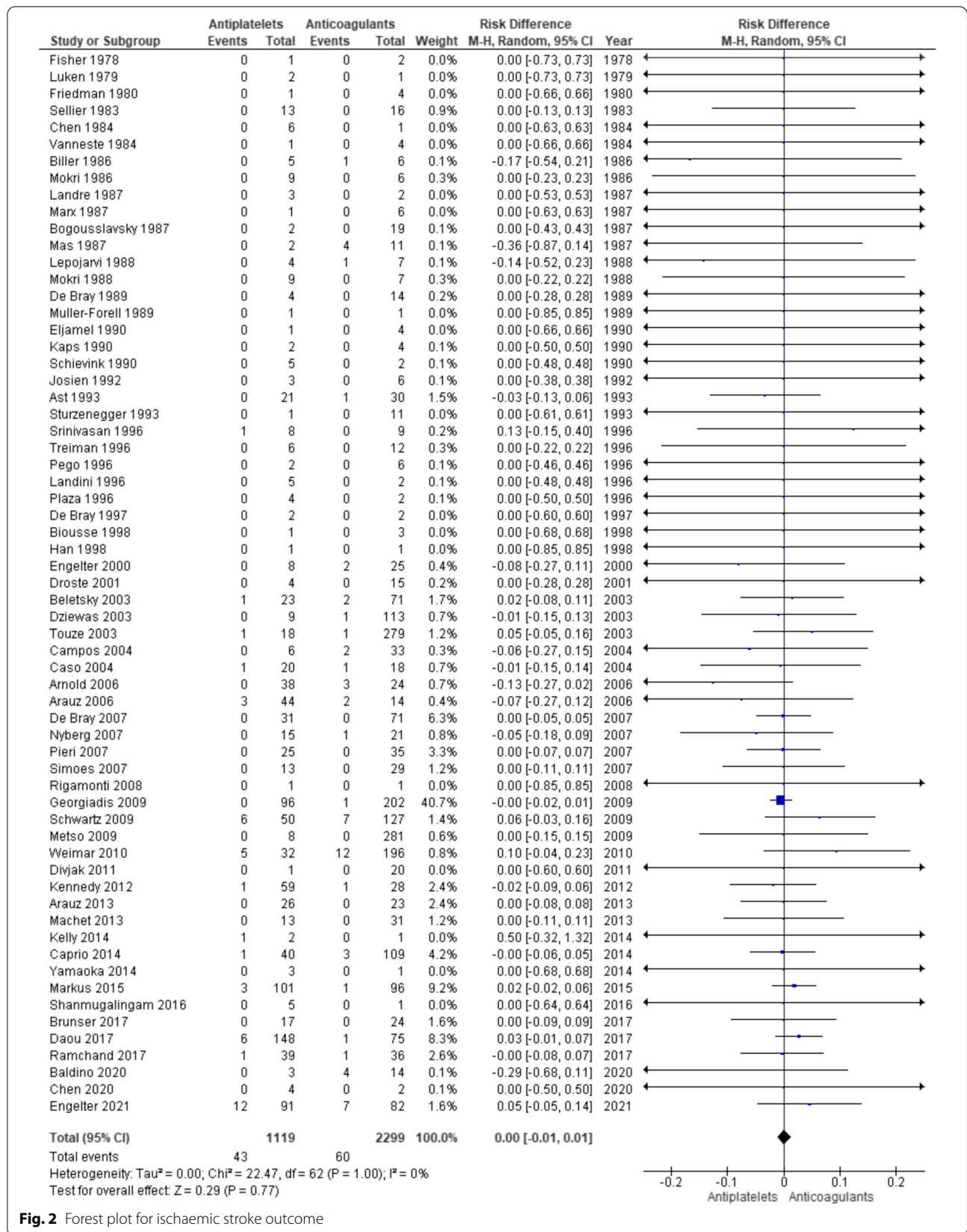


Fig. 2 Forest plot for ischaemic stroke outcome

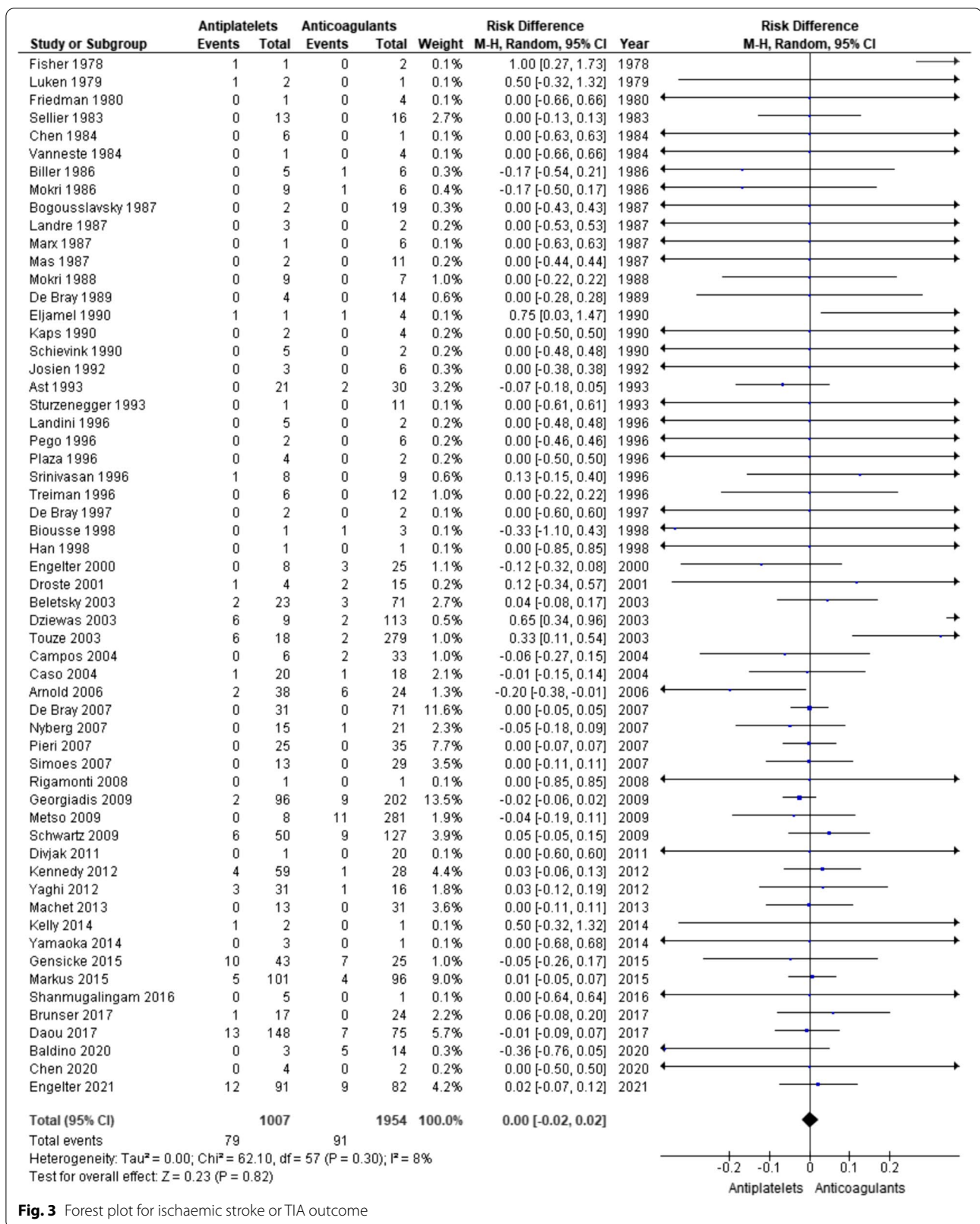


Fig. 3 Forest plot for ischaemic stroke or TIA outcome

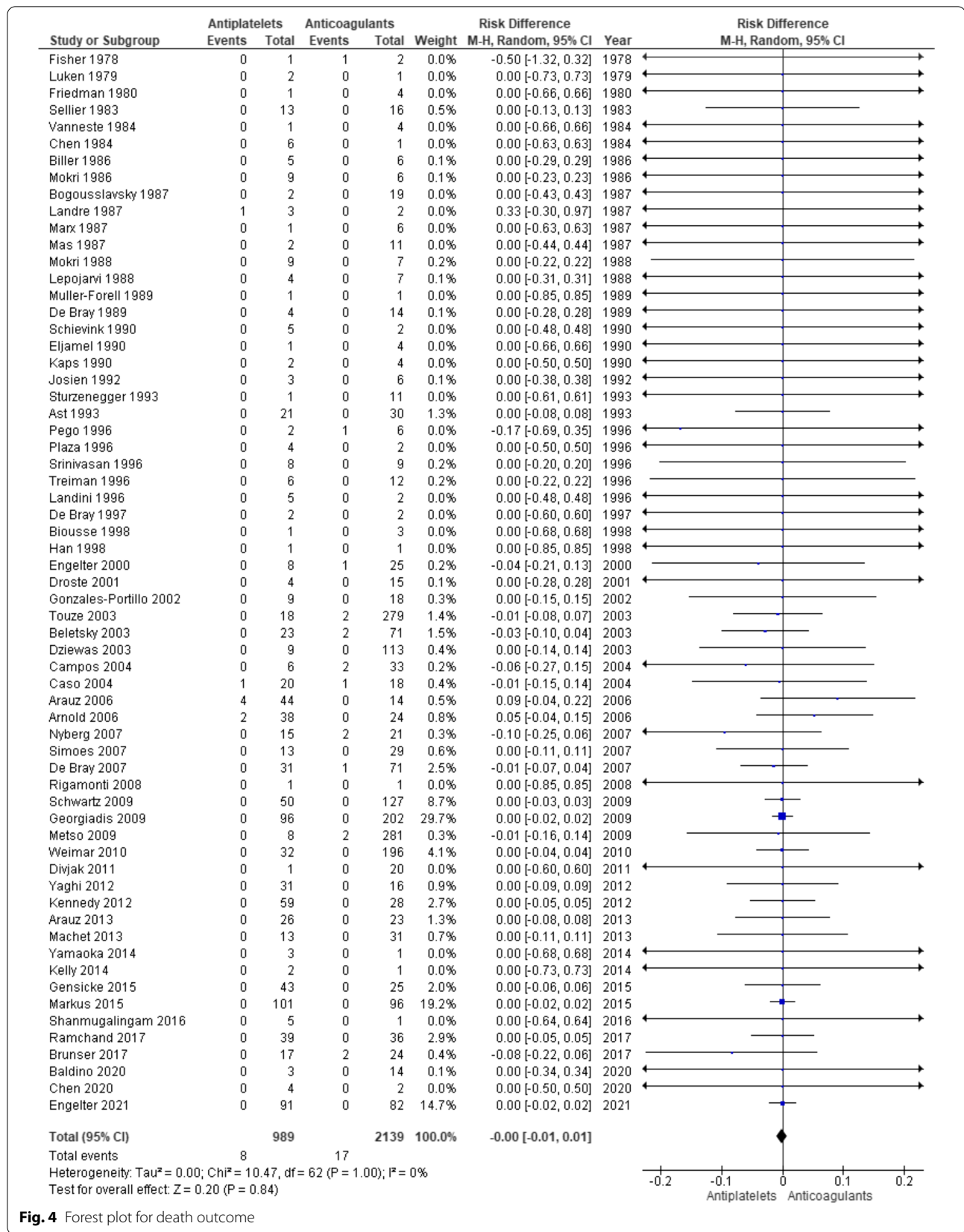
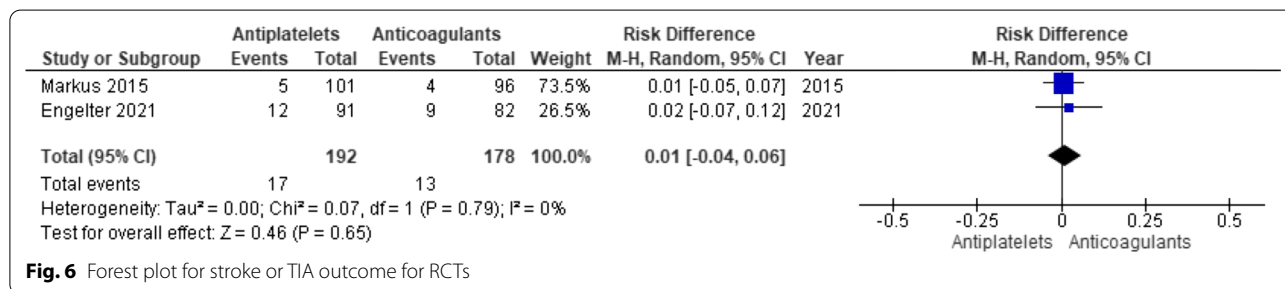
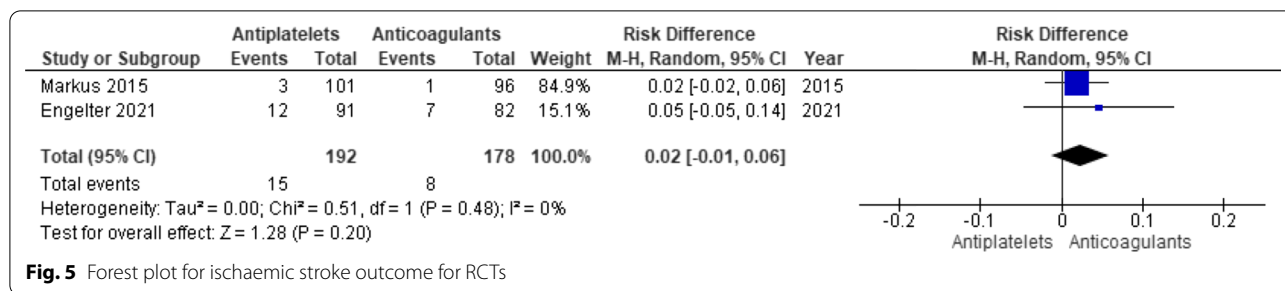


Fig. 4 Forest plot for death outcome



in 36 studies; 0.00 [−0.01, 0.01], p=0.91). [Please see the details in figure S1 to S3 in Additional file 1.]

Similarly, there are minimal risk differences with no statistical significance in the analyses for vertebral artery dissection alone: in favour of antiplatelet treatment for ischaemic stroke outcome (total 555 subjects in 19 studies; −0.02 [−0.06, 0.02], p=0.26), in favour of antiplatelet treatment for ischaemic stroke or TIA outcome (total 237 subjects in 15 studies; −0.02 [−0.08, 0.04], p=0.50), and in favour of anticoagulant treatment for death outcome (total 448 subjects in 19 studies; 0.01 [−0.04, 0.05], p=0.76). [Please see the details in Additional file 1: Figs. S4 to S6]

Discussion

In the literature, there have been five meta-analyses that compared the results of using antiplatelets and anticoagulants in the secondary prevention of cervical artery dissection [8, 10–13]. Despite the various methodologies used, there is still no conclusive evidence that either class of the antithrombotic medication is superior to the other. Present meta-analysis with updated data also failed to find statistically significant differences between the two treatments (Figs. 2, 3, 4). However, it differs from the rest in that there are two RCTs, CADISS and TREAT-CAD [6, 7], included in the present meta-analysis. Both of these RCTs included both internal carotid and vertebral artery dissections and each failed to show significant differences between the two treatments. This is in agreement with the results of the present meta-analyses overall or with

data from just these two RCTs (Figs. 5, 6) or with data on carotid and vertebral artery dissections separately (Additional file 1: Figs. S1 to S6).

CADISS was the first RCT to be published with the aim to determine the feasibility of a clinical trial to compare the effects of antiplatelets and anticoagulants in cervical artery dissection [80]. However, it found no statistically significant differences between the two treatments (in both per-protocol analysis and intention-to-treat analysis). Nonetheless, it highlighted that the diagnostic imaging criteria of dissection were often not applied correctly in clinical practice [6]. With the realization of lower than expected clinical outcome rates in CADISS and the RCT being underpowered, another RCT, TREAT-CAD, attempted to overcome this by adding MRI surrogate outcomes to determine non-inferiority of antiplatelets to anticoagulation [7]. However, TREAT-CAD found no significant differences between antiplatelets and anticoagulants nor non-inferiority of aspirin even after adding MRI findings, in both per-protocol and intention-to-treat analyses and despite a generous 12% non-inferiority margin.

CADISS also made power calculation using their findings on composite outcome of stroke, death or major bleeding (2.97%, 95% CI 0.62–8.44 with antiplatelets vs 2.08%, 95% CI 0.25–7.32 with anticoagulants) in per-protocol data to assess the feasibility of another trial. A sample size of 4876 individuals in each arm will be required for a study with 0.8 power and 0.05 significance level [6]. Such a trial would be too resource intensive and

would take a tremendous amount of time to complete. As a comparison, it took over seven years to recruit 250 subjects (in total and around 200 per-protocol subjects) in CADISS (UK alone) and over five years to recruit 194 subjects (in total and 173 per-protocol subjects) in TREAT-CAD (Switzerland, Germany, and Denmark).

Comparing effects of antiplatelets and anticoagulants in medical treatment of extracranial artery dissection without taking into consideration of initial presentation, type of dissection (aneurysmal or stenotic or occlusive) and other demographic characteristics may be an oversimplification of a complex picture. Nevertheless, treatment with antithrombotics appears to be effective regardless of the underlying characteristics and may improve the survival of individuals with internal carotid or vertebral artery dissections. Rosati et al. reported that individuals on either antiplatelet treatment or anticoagulant treatment have significantly lowered risk of adverse outcomes [Hazard Ratio (HR) 0.15, 95% CI: 0.04–0.55, $p=0.005$ and HR 0.19, 95% CI: 0.04–0.88, $p=0.034$, respectively] compared to those without either treatment [81].

Baseline differences in types of dissections could have introduced some biases and obscured actual difference between the two treatments, i.e. type II error. In fact, selection bias was looked at by Ramchand et al. where he determined that there was a significantly higher degree of stenosis in individuals on anticoagulants and a non-significantly higher chance of receiving anticoagulants by patients with “stroke or TIA.” [60] The latter point was a significant finding in Daou et al. in which patients who received antiplatelet treatment have the lowest chance of presenting with stroke compared to those who received anticoagulation or combined treatments [59]. Another one factor that increased the difficulty in finding differences between anticoagulation and antiplatelet treatment was due to the fact that heparin is commonly used in the initial phase of treatment in addition to an antiplatelet, and this (early anticoagulation) was recommended in the early versions of European guidelines on management of stroke [82, 83].

Evidence on direct oral anticoagulants (DOAC) are still limited with very small sample size studies [54, 84, 85]. Similarly, the evidence for dual antiplatelet treatment is limited. In CADISS, almost half of the participants (28% received aspirin and clopidogrel, and 16% received aspirin and dipyridamole) received dual antiplatelet treatment. But the outcomes reported did not differentiate between single and dual antiplatelet treatments. In total (per-protocol), there were 3% ischaemic stroke outcome, 5% any stroke or TIA outcome and 0% major bleeding outcome. In contrast, in TREAT-CAD, only single

antiplatelet treatment was used (Aspirin oral 300 mg or intravenous 250 mg). There were 8% ischaemic stroke, 0% TIA and 0% major bleeding (per-protocol sample). It is plausible that these differences in outcomes between these two RCTs could reflect the effects of single and dual antiplatelet treatments. However, more evidence is needed to either confirm or refute this.

Given the findings from CADISS and TREAT-CAD, there has been some consideration that the evidence to support antiplatelet treatment is weak albeit sufficient for the treatment of individuals with only symptoms and without haemodynamic compromise. Nevertheless, early treatment with either modality has been suggested, based on the finding that diffusion-weighted imaging (DWI) lesions have been detected to occur soon after diagnosis of the dissection [78].

Limitations

Present meta-analysis considered only three outcomes which did not include bleeding adverse effect which is a potentially problematic adverse effect associated with antithrombotics. Also, cases due to severe trauma are excluded which could be considered as valid clinical variant that needs equal clinical attention. Cases that were stented and surgically treated were excluded since they could potentially be different from medically treated patients and could introduce further bias into the analysis. Present meta-analysis included studies with follow up periods less than three months and these could have altered the actual rates of outcome events and the final results. Majority of the included studies are observational studies which are prone to different biases. Per-protocol data was favored over intention-to-treat data which might be a pragmatic choice but can introduce bias.

Conclusion

Present meta-analysis did not find significant differences between antiplatelet and anticoagulant treatments despite increased sample size. The choice of antithrombotics should be tailored to the patient on an individual basis.

Abbreviations

CADISS: Cervical artery dissection in stroke study; CCT: Controlled clinical trials; CENTRAL: Cochrane central register of controlled trials; CI: Confidence interval; CT: Computed tomography; DOAC: Direct oral anticoagulants; DWI: Diffusion-weighted imaging; HR: Hazard ratio; MRI: Magnetic resonance imaging; OR: Odd ratio; PICO: Population, intervention, comparison, outcome and study design; PRISMA: Preferred reporting items for systematic reviews and meta-analyses; RCT: Randomized controlled trials; RD: Risk difference; RR: Risk ratio; TIA: Transient ischaemic attack; TREAT-CAD: Biomarkers and antithrombotic treatment in cervical artery dissection.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s42466-022-00188-7>.

Additional file 1: Table S1. Search words used and the steps involved for MEDLINE database search. **Figure S1.** Forest plot for ischaemic stroke outcome in carotid artery dissection alone. **Figure S2.** Forest plot for ischaemic stroke or TIA outcome in carotid artery dissection alone. **Figure S3.** Forest plot for death outcome in carotid artery dissection alone. **Figure S4.** Forest plot for ischaemic stroke outcome in vertebral artery dissection alone. **Figure S5.** Forest plot for ischaemic stroke or TIA outcome in vertebral artery dissection alone. **Figure S6.** Forest plot for death outcome in vertebral artery dissection alone.

Acknowledgements

Not applicable

Author contributions

The meta-analysis was conceived and planned by EZT, CSRS, and HLT. Data acquisition was done by EZT, NNL, CJC, and JCWL. Data analysis was done by EZT and NNL. The interpretation of the results were done by EZT, NNL, BYQT, CSRS, HLT, JV, and LLLY. Manuscript drafting was done by EZT, NNL, CJC, and JCWL and revised critically by EZT, BYQT, CSRS, HLT, JV, and LLLY. All authors agreed on and accountable for the final version to be published. All authors read and approved the final manuscript.

Funding

The study acquired no funding.

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

The authors did not seek ethics approval since the study uses existing data from previously published articles.

Consent for publication

Not applicable.

Competing interest

The authors declare that they have no competing interests.

Author details

¹Division of Neurology, Department of Medicine, National University Hospital, Singapore, Singapore. ²University Hospitals of Leicester NHS Trust, Leicester, UK. ³Leicester General Hospital, Gwendolen Rd, Leicester LE5 4PW, UK. ⁴University of Medicine 1, Yangon, Myanmar. ⁵National University of Singapore, Singapore, Singapore.

Received: 15 March 2022 Accepted: 5 May 2022

Published online: 13 June 2022

References

- Leys, D., Bandu, L., Hénon, H., Lucas, C., Mounier-Vehier, F., Rondepierre, P., & Godefroy, O. (2002). Clinical outcome in 287 consecutive young adults (15 to 45 years) with ischemic stroke. *Neurology*, *59*(1), 26–33. <https://doi.org/10.1212/wnl.59.1.26>
- Putala, J., Metso, A. J., Metso, T. M., Konkola, N., Kraemer, Y., Haapaniemi, E., Kaste, M., & Tatlisumak, T. (2009). Analysis of 1008 consecutive patients aged 15 to 49 with first-ever ischemic stroke: The Helsinki young stroke registry. *Stroke*, *40*(4), 1195–1203. <https://doi.org/10.1161/STROKEAHA.108.529883>
- Compter, A., Schilling, S., Vaineau, C. J., Goeggel-Simonetti, B., Metso, T. M., Southerland, A., Pezzini, A., Kloss, M., Touzé, E., Worrall, B. B., Thijs, V., Bejot, Y., Reiner, P., Grond-Ginsbach, C., Bersano, A., Brandt, T., Caso, V., Lyrer, P. A., Traenka, C., ... CADISP-plus Consortium. (2018). Determinants and outcome of multiple and early recurrent cervical artery dissections. *Neurology*, *91*(8), e769–e780. <https://doi.org/10.1212/WNL.0000000000006037>
- Debette, S., & Leys, D. (2009). Cervical-artery dissections: Predisposing factors, diagnosis, and outcome. *The Lancet. Neurology*, *8*(7), 668–678. [https://doi.org/10.1016/S1474-4422\(09\)70084-5](https://doi.org/10.1016/S1474-4422(09)70084-5)
- Billir, J., Sacco, R. L., Albuquerque, F. C., Demaerschalk, B. M., Fayad, P., Long, P. H., Noorollah, L. D., Panagos, P. D., Schievink, W. I., Schwartz, N. E., Shuaib, A., Thaler, D. E., Tirschwell, D. L., & Council, A. H. A. S. (2014). Cervical arterial dissections and association with cervical manipulative therapy: A statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *45*(10), 3155–3174. <https://doi.org/10.1161/STR.0000000000000116>
- CADISS trial investigators, Markus, H. S., Hayter, E., Levi, C., Feldman, A., Venables, G., & Norris, J. (2015). Antiplatelet treatment compared with anticoagulation treatment for cervical artery dissection (CADISS): A randomised trial. *The Lancet. Neurology*, *14*(4), 361–367. [https://doi.org/10.1016/S1474-4422\(15\)70018-9](https://doi.org/10.1016/S1474-4422(15)70018-9)
- Engelter, S. T., Traenka, C., Gensicke, H., Schaedelin, S. A., Luft, A. R., Simonetti, B. G., Fischer, U., Michel, P., Sirimarco, G., Kägi, G., Vehofoff, J., Nedeltchev, K., Kahles, T., Kellert, L., Rosenbaum, S., von Rennenberg, R., Sztajzel, R., Leib, S. L., Jung, S., Gralla, J., et al. (2021). Aspirin versus anticoagulation in cervical artery dissection (TREAT-CAD): An open-label, randomised, non-inferiority trial. *The Lancet. Neurology*, *20*(5), 341–350. [https://doi.org/10.1016/S1474-4422\(21\)00044-2](https://doi.org/10.1016/S1474-4422(21)00044-2)
- Menon, R., Kerry, S., Norris, J. W., & Markus, H. S. (2008). Treatment of cervical artery dissection: A systematic review and meta-analysis. *Journal of Neurology, Neurosurgery, and Psychiatry*, *79*(10), 1122–1127. <https://doi.org/10.1136/jnnp.2007.138800>
- Kim, Y. K., & Schulman, S. (2009). Cervical artery dissection: Pathology, epidemiology and management. *Thrombosis Research*, *123*(6), 810–821. <https://doi.org/10.1016/j.thromres.2009.01.013>
- Lyrer, P., & Engelter, S. (2010). Antithrombotic drugs for carotid artery dissection. *The Cochrane Database of Systematic Reviews*, *10*, CD000255. <https://doi.org/10.1002/14651858.CD000255.pub2>
- Kennedy, F., Lanfranconi, S., Hicks, C., Reid, J., Gompertz, P., Price, C., Kerry, S., Norris, J., Markus, H. S., & Investigators, C. A. D. I. S. S. (2012). Antiplatelets vs anticoagulation for dissection: CADISS nonrandomized arm and meta-analysis. *Neurology*, *79*(7), 686–689. <https://doi.org/10.1212/WNL.0b013e318264e36b>
- Sarikaya, H., da Costa, B. R., Baumgartner, R. W., Duclos, K., Touzé, E., de Bray, J. M., Metso, A., Metso, T., Arnold, M., Arauz, A., Zwahlen, M., & Jüni, P. (2013). Antiplatelets versus anticoagulants for the treatment of cervical artery dissection: Bayesian meta-analysis. *PLoS ONE*, *8*(9), e72697. <https://doi.org/10.1371/journal.pone.0072697>
- Chowdhury, M. M., Sabbagh, C. N., Jackson, D., Coughlin, P. A., & Ghosh, J. (2015). Antithrombotic treatment for acute extracranial carotid artery dissections: A meta-analysis. *European Journal of Vascular and Endovascular Surgery: The Official Journal of the European Society for Vascular Surgery*, *50*(2), 148–156. <https://doi.org/10.1016/j.ejvs.2015.04.034>
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Declaración PRISMA 2020: Una guía actualizada para la publicación de revisiones sistemáticas. Revista Espanola de Cardiologia (English ed.)*, *74*(9), 790–799.
- Review Manager (RevMan) [Computer program]. Version 5.4. The Cochrane Collaboration, 2020.
- Billir, J., Hingtgen, W. L., Adams, H. P., Jr., Smoker, W. R., Godersky, J. C., & Toffol, G. J. (1986). Cervicocephalic arterial dissections. A ten-year experience. *Archives of Neurology*, *43*(12), 1234–1238. <https://doi.org/10.1001/archneur.1986.00520120019010>
- Bogousslavsky, J., Despland, P. A., & Regli, F. (1987). Spontaneous carotid dissection with acute stroke. *Archives of Neurology*, *44*(2), 137–140. <https://doi.org/10.1001/archneur.1987.00520140009010>
- Landre, E., Roux, F. X., & Cioloca, C. (1987). Dissection spontanée de la carotide interne exocrânienne. Aspects thérapeutiques [Spontaneous dissection of the exocranial internal carotid artery. Therapeutic aspects]. *Presse medicale (Paris, France)*, *16*(26), 1273–1276.

19. Marx, A., Messing, B., Storch, B., & Busse, O. (1987). Spontane Dissektionen hirnversorgender Arterien [Spontaneous dissection of arteries supplying the brain]. *Der Nervenarzt*, 58(1), 8–18.
20. Mas, J. L., Bousser, M. G., Hasboun, D., & Laplane, D. (1987). Extracranial vertebral artery dissections: A review of 13 cases. *Stroke*, 18(6), 1037–1047. <https://doi.org/10.1161/01.str.18.6.1037>
21. Lepojärvi, M., Tarkka, M., Leinonen, A., & Kallanranta, T. (1988). Spontaneous dissection of the internal carotid artery. *Acta Chirurgica Scandinavica*, 154(10), 559–566.
22. de Bray, J. M., Dubas, F., Joseph, P. A., Causeret, H., Pasquier, J. P., & Emile, J. (1989). Etude ultrasonique de 22 dissections carotidiennes [Ultrasonic study of 22 cases of carotid artery dissection]. *Revue Neurologique*, 145(10), 702–709.
23. Müller-Forell, W., Rothacher, G., & Krämer, G. (1989). Carotis-Dissektionen [Carotid dissections]. *Der Radiologe*, 29(9), 432–436.
24. Eljamel, M. S., Humphrey, P. R., & Shaw, M. D. (1990). Dissection of the cervical internal carotid artery. The role of Doppler/Duplex studies and conservative management. *Journal of Neurology, Neurosurgery, and Psychiatry*, 53(5), 379–383. <https://doi.org/10.1136/jnnp.53.5.379>
25. Schievink, W. I., & Limburg, M. (1990). Dissectie van cervicale arteriën als oorzaak van hersenischemie of uitval van hersenzenuwen [Dissection of cervical arteries as a cause of cerebral ischemia or cranial nerve dysfunction]. *Nederlands Tijdschrift Voor Geneeskunde*, 134(38), 1843–1848.
26. Josien, E. (1992). Extracranial vertebral artery dissection: Nine cases. *Journal of Neurology*, 239(6), 327–330. <https://doi.org/10.1007/BF00867589>
27. Ast, G., Woimant, F., Georges, B., Laurian, C., & Haguena, M. (1993). Spontaneous dissection of the internal carotid artery in 68 patients. *The European Journal of Medicine*, 2(8), 466–472.
28. Sturzenegger, M., Mattle, H. P., Rivoir, A., Rihs, F., & Schmid, C. (1993). Ultrasound findings in spontaneous extracranial vertebral artery dissection. *Stroke*, 24(12), 1910–1921. <https://doi.org/10.1161/01.str.24.12.1910>
29. Pego, R., Marey, J., López-Facal, M. S., & Marín-Sánchez, M. (1996). Dissección de la arteria vertebral extracraneal: Ocho casos [Eight cases of extracranial vertebral artery dissection]. *Revista de Neurología*, 24(126), 172–175.
30. Plaza, I., Díez-Tejedor, E., Lara, M., & Barreiro, P. (1996). Dissección espontánea de arteria vertebral [Spontaneous dissection of the vertebral artery]. *Revista de Neurología*, 24(126), 163–171.
31. Srinivasan, J., Newell, D. W., Sturzenegger, M., Mayberg, M. R., & Winn, H. R. (1996). Transcranial Doppler in the evaluation of internal carotid artery dissection. *Stroke*, 27(7), 1226–1230. <https://doi.org/10.1161/01.str.27.7.1226>
32. Treiman, G. S., Treiman, R. L., Foran, R. F., Levin, P. M., Cohen, J. L., Wagner, W. H., & Cossman, D. V. (1996). Spontaneous dissection of the internal carotid artery: A nineteen-year clinical experience. *Journal of Vascular Surgery*, 24(4), 597–607. [https://doi.org/10.1016/s0741-5214\(96\)70075-7](https://doi.org/10.1016/s0741-5214(96)70075-7)
33. de Bray, J. M., Penisson-Besnier, I., Dubas, F., & Emile, J. (1997). Extracranial and intracranial vertebrobasilar dissections: Diagnosis and prognosis. *Journal of Neurology, Neurosurgery, and Psychiatry*, 63(1), 46–51. <https://doi.org/10.1136/jnnp.63.1.46>
34. Han, D. H., Kwon, O. K., & Oh, C. W. (1998). Clinical characteristics of vertebrobasilar artery dissection. *Neurologia Medico-Chirurgica*, 38(Suppl), 107–113. https://doi.org/10.2176/nmc.38.suppl_107
35. Engelter, S. T., Lyrer, P. A., Kirsch, E. C., & Steck, A. J. (2000). Long-term follow-up after extracranial internal carotid artery dissection. *European Neurology*, 44(4), 199–204. <https://doi.org/10.1159/00008236>
36. Droste, D. W., Junker, K., Stögbauer, F., Lowens, S., Besselmann, M., Braun, B., & Ringelstein, E. B. (2001). Clinically silent circulating microemboli in 20 patients with carotid or vertebral artery dissection. *Cerebrovascular Diseases (Basel, Switzerland)*, 12(3), 181–185. <https://doi.org/10.1159/000047701>
37. Gonzales-Portillo, F., Bruno, A., & Biller, J. (2002). Outcome of extracranial cervicocephalic arterial dissections: A follow-up study. *Neurological Research*, 24(4), 395–398. <https://doi.org/10.1179/016164102101200087>
38. Beletsky, V., Nadareishvili, Z., Lynch, J., Shuaib, A., Woolfenden, A., Norris, J. W., Canadian Stroke Consortium. (2003). Cervical arterial dissection: time for a therapeutic trial? *Stroke*, 34(12), 2856–2860. <https://doi.org/10.1161/01.STR.0000098649.39767.BC>
39. Campos, C. R., Evaristo, E. F., Yamamoto, F. I., Puglia, P., Jr., Lucato, L. T., & Scaff, M. (2004). Dissecção espontânea cervical carotídea e vertebral: Estudo de 48 pacientes [Spontaneous cervical carotid and vertebral arteries dissection: Study of 48 patients]. *Arquivos de Neuro-Psiquiatria*, 62(2B), 492–498. <https://doi.org/10.1590/s0004-282x2004000300021>
40. Caso, V., Paciaroni, M., Corea, F., Hamam, M., Milia, P., Pelliccioli, G. P., Parnetti, L., & Gallai, V. (2004). Recanalization of cervical artery dissection: Influencing factors and role in neurological outcome. *Cerebrovascular Diseases (Basel, Switzerland)*, 17(2–3), 93–97. <https://doi.org/10.1159/000075775>
41. Arauz, A., Hoyos, L., Espinoza, C., Cantú, C., Barinagarrementeria, F., & Román, G. (2006). Dissection of cervical arteries: Long-term follow-up study of 130 consecutive cases. *Cerebrovascular Diseases (Basel, Switzerland)*, 22(2–3), 150–154. <https://doi.org/10.1159/000093244>
42. Arnold, M., Bousser, M. G., Fahrni, G., Fischer, U., Georgiadis, D., Gandjour, J., Benninger, D., Sturzenegger, M., Mattle, H. P., & Baumgartner, R. W. (2006). Vertebral artery dissection: Presenting findings and predictors of outcome. *Stroke*, 37(10), 2499–2503. <https://doi.org/10.1161/01.STR.0000240493.88473.39>
43. de Bray, J. M., Marc, G., Pautot, V., Vielle, B., Pasco, A., Lhoste, P., & Dubas, F. (2007). Fibromuscular dysplasia may herald symptomatic recurrence of cervical artery dissection. *Cerebrovascular Diseases (Basel, Switzerland)*, 23(5–6), 448–452. <https://doi.org/10.1159/000101470>
44. Nyberg, J., Olsson, T., & Malm, J. (2007). Karotis- och vertebralisdissektion vanlig orsak till stroke hos yngre. Lindrigt trauma utlösande faktor hos mer än hälften, visar retrospektiv studie [Carotid and vertebral artery dissection a common cause of stroke among younger persons. Minor trauma a precipitating factor in more than fifty percent according to a retrospective study]. *Läkartidningen*, 104(1–2), 24–28.
45. Pieri, A., Spitz, M., Valiente, R. A., Avelar, W. M., Silva, G. S., & Massaro, A. R. (2007). Dissecção espontânea das artérias carótidas e vertebrais em uma população multiétnica [Spontaneous carotid and vertebral arteries dissection in a multiethnic population]. *Arquivos de Neuro-Psiquiatria*, 65(4A), 1050–1055. <https://doi.org/10.1590/s0004-282x2007000600029>
46. Rigamonti, A., Iurlaro, S., Reganati, P., Zilioli, A., & Agostoni, E. (2008). Cluster headache and internal carotid artery dissection: Two cases and review of the literature. *Headache*, 48(3), 467–470. <https://doi.org/10.1111/j.1526-4610.2007.01034.x>
47. Georgiadis, D., Arnold, M., von Buedingen, H. C., Valko, P., Sarikaya, H., Rousson, V., Mattle, H. P., Bousser, M. G., & Baumgartner, R. W. (2009). Aspirin vs anticoagulation in carotid artery dissection: A study of 298 patients. *Neurology*, 72(21), 1810–1815. <https://doi.org/10.1212/WNL.0b013e3181a2a50a>
48. Schwartz, N. E., Vertinsky, A. T., Hirsch, K. G., & Albers, G. W. (2009). Clinical and radiographic natural history of cervical artery dissections. *Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association*, 18(6), 416–423. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2008.11.016>
49. Weimar, C., Kraywinkel, K., Hagemeyer, C., Haass, A., Katsarava, Z., Brunner, F., Haverkamp, C., Schmid, E., Diener, H. C., German Stroke Study Collaboration. (2010). Recurrent stroke after cervical artery dissection. *Journal of Neurology, Neurosurgery, and Psychiatry*, 81(8), 869–873. <https://doi.org/10.1136/jnnp.2009.192153>
50. Divjak, I., Slankamenac, P., Jovičević, M., Zikić, T. R., Prokin, A. L., & Jovanović, A. (2011). A case series of 22 patients with internal carotid artery dissection. *Medicinski Pregled*, 64(11–12), 575–578.
51. Yaghi, S., Maalouf, N., & Keyrouz, S. G. (2012). Cervical artery dissection: Risk factors, treatment, and outcome; a 5-year experience from a tertiary care center. *The International Journal of Neuroscience*, 122(1), 40–44. <https://doi.org/10.3109/00207454.2011.622453>
52. Arauz, A., Ruiz, A., Pacheco, G., Rojas, P., Rodríguez-Armida, M., Cantú, C., Murillo-Bonilla, L., Ruiz-Sandoval, J. L., & Barinagarrementeria, F. (2013). Aspirin versus anticoagulation in intra- and extracranial vertebral artery dissection. *European Journal of Neurology*, 20(1), 167–172. <https://doi.org/10.1111/j.1468-1331.2012.03825.x>
53. Machet, A., Fonseca, A. C., Oppenheim, C., Touzé, E., Meder, J. F., Mas, J. L., & Naggara, O. (2013). Does anticoagulation promote mural hematoma growth or delayed occlusion in spontaneous cervical artery dissections? *Cerebrovascular Diseases (Basel, Switzerland)*, 35(2), 175–181. <https://doi.org/10.1159/000346592>
54. Caprio, F. Z., Bernstein, R. A., Alberts, M. J., Curran, Y., Bergman, D., Korutz, A. W., Syed, F., Ansari, S. A., & Prabhakaran, S. (2014). Efficacy and safety of novel oral anticoagulants in patients with cervical artery dissections. *Cerebrovascular Diseases (Basel, Switzerland)*, 38(4), 247–253. <https://doi.org/10.1159/000366265>
55. Kelly, J. C., Safain, M. G., Roguski, M., Edlow, A. G., & Malek, A. M. (2014). Postpartum internal carotid and vertebral arterial dissections. *Obstetrics and Gynecology*, 123(4), 848–856. <https://doi.org/10.1097/AOG.0000000000000189>

56. Yamaoka, Y., Ichikawa, Y., Kimura, T., Sameshima, T., Ochiai, C., & Morita, A. (2014). A novel method for transcranial Doppler microembolic signal monitoring at the vertebrobasilar junction in vertebral artery dissection patients. *Journal of Neuroimaging: Official Journal of the American Society of Neuroimaging*, 24(2), 191–194. <https://doi.org/10.1111/j.1552-6569.2012.00749.x>
57. Shanmugalingam, R., Reza Pour, N., Chuah, S. C., Vo, T. M., Beran, R., Hennessy, A., & Makris, A. (2016). Vertebral artery dissection in hypertensive disorders of pregnancy: A case series and literature review. *BMC Pregnancy and Childbirth*, 16(1), 164. <https://doi.org/10.1186/s12884-016-0953-5>
58. Brunser, A. M., Lavados, P. M., Hoppe, A., Muñoz-Venturelli, P., Sujima, E., López, J., Mansilla, E., Cárcamo, D., & Díaz, V. (2017). Transcranial doppler as a predictor of ischemic events in carotid artery dissection. *Journal of Neuroimaging: Official Journal of the American Society of Neuroimaging*, 27(2), 232–236. <https://doi.org/10.1111/jon.12379>
59. Daou, B., Hammer, C., Mouchtouris, N., Starke, R. M., Koduri, S., Yang, S., Jabbour, P., Rosenwasser, R., & Tjoumakaris, S. (2017). Anticoagulation vs antiplatelet treatment in patients with carotid and vertebral artery dissection: A study of 370 patients and literature review. *Neurosurgery*, 80(3), 368–379. <https://doi.org/10.1093/neuros/nyw086>
60. Ramchand, P., Mullen, M. T., Bress, A., Hurst, R., Kasner, S. E., Cucchiara, B. L., & Messé, S. R. (2018). Recanalization after extracranial dissection: Effect of antiplatelet compared with anticoagulant therapy. *Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association*, 27(2), 438–444. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2017.09.065>
61. Baldino, G., Di Girolamo, C., De Blasis, G., & Gori, A. (2020). Eagle syndrome and internal carotid artery dissection: Description of five cases treated in two Italian institutions and review of the literature. *Annals of Vascular Surgery*, 67, 565.e17–565.e24. <https://doi.org/10.1016/j.avsg.2020.02.033>
62. Chen, F., Liu, X., Qiu, T., Jia, C., Liu, M., Jin, Q., Gao, P., & Li, X. (2020). Cervical posterior Spinal artery syndrome caused by spontaneous vertebral artery dissection: Two case reports and literature review. *Journal of Stroke and Cerebrovascular Diseases: The Official Journal of National Stroke Association*, 29(3), 104601. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2019.104601>
63. Fisher, C. M., Ojemann, R. G., & Roberson, G. H. (1978). Spontaneous dissection of cervico-cerebral arteries. *The Canadian Journal of Neurological Sciences. Le Journal Canadien des Sciences Neurologiques*, 5(1), 9–19.
64. Luken, M. G., 3rd, Ascherl, G. F., Jr., Correll, J. W., & Hilal, S. K. (1979). Spontaneous dissecting aneurysms of the extracranial internal carotid artery. *Clinical Neurosurgery*, 26, 353–375. https://doi.org/10.1093/neurosurgery/26.cn_suppl_1.353
65. Friedman, W. A., Day, A. L., Quisling, R. G., Sybert, G. W., & Rhoton, A. L., Jr. (1980). Cervical carotid dissecting aneurysms. *Neurosurgery*, 7(3), 207–214. <https://doi.org/10.1227/00006123-198009000-00001>
66. Sellier, N., Chiras, J., Benhamou, M., & Bories, J. (1983). Spontaneous dissection of the internal carotid artery. Clinical, radiologic and evolutive aspects. Apropos of 46 cases. *Journal of Neuroradiology = Journal de Neuroradiologie*, 10(3), 243–259.
67. Chen, S. T., Ryu, S. J., & Hsi, M. S. (1984). Cervico-cerebral artery dissection. *Taiwan yi xue hui za zhi. Journal of the Formosan Medical Association*, 83(8), 846–861.
68. Vanneste, J. A., & Davies, G. (1984). Spontaneous dissection of the cervical internal carotid artery. *Clinical Neurology and Neurosurgery*, 86(4), 307–314. [https://doi.org/10.1016/0303-8467\(84\)90295-6](https://doi.org/10.1016/0303-8467(84)90295-6)
69. Mokri, B., Sundt, T. M., Jr., Houser, O. W., & Piepgras, D. G. (1986). Spontaneous dissection of the cervical internal carotid artery. *Annals of Neurology*, 19(2), 126–138. <https://doi.org/10.1002/ana.410190204>
70. Mokri, B., Houser, O. W., Sandok, B. A., & Piepgras, D. G. (1988). Spontaneous dissections of the vertebral arteries. *Neurology*, 38(6), 880–885. <https://doi.org/10.1212/wnl.38.6.880>
71. Kaps, M., Dorndorf, W., Damian, M. S., & Agnoli, L. (1990). Intracranial haemodynamics in patients with spontaneous carotid dissection. Transcranial Doppler ultrasound follow-up studies. *European Archives of Psychiatry and Neurological Sciences*, 239(4), 246–256. <https://doi.org/10.1007/BF01738579>
72. Landini, G., Cordopatri, F., Scarti, L., Spolveri, S., Pennati, P., & Rosselli, A. (1996). Dissezione dei vasi epiaortici: una patologia emergente come causa di ischemia cerebrale focale. Valutazione di una casistica di 7 pazienti [Dissection of the epiaortic vessels: an emergency pathology as the cause of focal cerebral ischemia. The evaluation of a case load of 7 patients]. *Annali Italiani di Medicina Interna: Organo Ufficiale Della Società Italiana di Medicina Interna*, 11(1), 12–16.
73. Bioussé, V., Schaison, M., Touboul, P. J., D'Anglejan-Chatillon, J., & Bousser, M. G. (1998). Ischemic optic neuropathy associated with internal carotid artery dissection. *Archives of Neurology*, 55(5), 715–719. <https://doi.org/10.1001/archneur.55.5.715>
74. Dziejwas, R., Konrad, C., Dräger, B., Evers, S., Besselmann, M., Lüdemann, P., Kühlenbäumer, G., Stögbauer, F., & Ringelstein, E. B. (2003). Cervical artery dissection—clinical features, risk factors, therapy and outcome in 126 patients. *Journal of Neurology*, 250(10), 1179–1184. <https://doi.org/10.1007/s00415-003-0174-5>
75. Touzé, E., Gauvrit, J. Y., Moulin, T., Meder, J. F., Bracad, S., Mas, J. L., Multicenter Survey on Natural History of Cervical Artery Dissection. (2003). Risk of stroke and recurrent dissection after a cervical artery dissection: A multicenter study. *Neurology*, 61(10), 1347–1351. <https://doi.org/10.1212/01.wnl.0000094325.95097.86>
76. Simões, R., Biscoito, L., Parreira, E., & Pinto, A. (2007). A comparison study of cervical artery dissections—hospital series of 61 patients. *Sinapse*, 7, 36–43.
77. Metso, T. M., Metso, A. J., Salonen, O., Haapaniemi, E., Putaala, J., Arttö, V., Helenius, J., Kaste, M., & Tatlisumak, T. (2009). Adult cervicocerebral artery dissection: A single-center study of 301 Finnish patients. *European Journal of Neurology*, 16(6), 656–661. <https://doi.org/10.1111/j.1468-1331.2009.02535.x>
78. Gensicke, H., Ahlhelm, F., Jung, S., von Hessling, A., Traenka, C., Goeggel Simonetti, B., Peters, N., Bonati, L. H., Fischer, U., Broeg-Morvay, A., Seiffge, D. J., Gralla, J., Stippich, C., Baumgartner, R. W., Lyrer, P. A., Arnold, M., & Engelter, S. T. (2015). New ischaemic brain lesions in cervical artery dissection stratified to antiplatelets or anticoagulants. *European Journal of Neurology*, 22(5), 859–e61. <https://doi.org/10.1111/ene.12682>
79. Markus, H. S., Levi, C., King, A., Madigan, J., Norris, J., Cervical Artery Dissection in Stroke Study (CADISS) Investigators. (2019). Antiplatelet therapy vs anticoagulation therapy in cervical artery dissection: the cervical artery dissection in stroke study (CADISS) randomized clinical trial final results. *JAMA Neurology*, 76(6), 657–664. <https://doi.org/10.1001/jamaneurol.2019.0072>
80. Cervical Artery Dissection in Stroke Study Trial Investigators. (2007). Antiplatelet therapy vs. anticoagulation in cervical artery dissection: rationale and design of the cervical artery dissection in stroke study (CADISS). *International Journal of Stroke: Official Journal of the International Stroke Society*, 2(4), 292–296. <https://doi.org/10.1111/j.1747-4949.2007.00165.x>
81. Rosati, L. M., Vezzetti, A., Redd, K. T., McMillan, B., Giamberardino, L., Kodumuri, N., Kothari, R., Yallapragada, A. V., & Sen, S. (2020). Early anticoagulation or antiplatelet therapy is critical in craniocervical artery dissection: results from the COMPASS registry. *Cerebrovascular Diseases (Basel, Switzerland)*, 49(4), 369–374. <https://doi.org/10.1159/000509415>
82. Hacke, W., Kaste, M., Skyhoj Olsen, T., Orgogozo, J. M., & Bogousslavsky, J. (2000). European Stroke Initiative (EUSI) recommendations for stroke management. The European Stroke Initiative Writing Committee. *European Journal of Neurology*, 7(6), 607–623. <https://doi.org/10.1046/j.1468-1331.2000.00137.x>
83. Committee, E. S. I. E., Writing Committee, E. U. S. I., Olsen, T. S., Langhorne, P., Diener, H. C., Hennerici, M., Ferro, J., Sivenius, J., Wahlgren, N. G., & Bath, P. (2003). European stroke initiative recommendations for stroke management—update 2003. *Cerebrovascular Diseases (Basel, Switzerland)*, 16(4), 311–337. <https://doi.org/10.1159/000072554>
84. Mustanoja, S., Metso, T. M., Putaala, J., Heikkinen, N., Haapaniemi, E., Salonen, O., & Tatlisumak, T. (2015). Helsinki experience on nonvitamin K oral anticoagulants for treating cervical artery dissection. *Brain and Behavior*, 5(8), e00349. <https://doi.org/10.1002/brb3.349>
85. Cappellari, M., & Bovi, P. (2017). Direct oral anticoagulants in patients with cervical artery dissection and cerebral venous thrombosis. A case series and review of the literature. *International Journal of Cardiology*, 244, 282–284. <https://doi.org/10.1016/j.ijcard.2017.06.006>

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.