

Characteristics from the 100 most influential articles on carotid stenosis

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Background: There are three main competing treatment modalities for carotid artery stenosis (CS), i.e., carotid endarterectomy (CEA), carotid artery angioplasty/stenting (CAS), and medical treatment. In this study, we analyzed the performance and trends of CS research through bibliometric analysis.

Methods: We searched the Thomson Reuters Web of Science citation indexing database. The key words used in the search were “carotid artery” and “carotid stenosis”. The top 100 most cited manuscripts (T100) were analyzed based on title, author, institution, country of origin, year of publication, and topic.

Results: The T100 were published between 1990 and 2016. The *Stroke* published the most manuscripts (n=22) and the *New England Journal of Medicine* was the most cited (n=15,113). The United States had the greatest number of publications (n=43), and the University of Oxford was the institution with the most publications (n=7). Peter M. Rothwell was the corresponding author with the most publications (n=10). The main topics were in the following categories: CEA (n=22), medication (n=11), CAS (n=9), diagnosis (n=44), and CEA vs. CAS (n=14).

Conclusions: This bibliometric analysis of CS research provides insight into publication trends and perspective on the treatment of CS.

Keywords: Carotid stenosis (CS); carotid endarterectomy (CEA); angioplasty; bibliometric analysis

Submitted Nov 19, 2021. Accepted for publication Dec 24, 2021.

doi: 10.21037/apm-21-3420

View this article at: <https://dx.doi.org/10.21037/apm-21-3420>

Introduction

Carotid artery stenosis, or carotid stenosis (CS), is responsible for 8–12% of all ischemic stroke cases. Indeed, CS is an important preventable cause of ischemic stroke (1). Close monitoring and intervention are recommended for patients with moderate and severe (50–99%) CS and symptomatic CS (such as transient ischemic attacks) (2). Advances in treatment modalities, including carotid artery angioplasty/stenting (CAS) have helped diversify treatment options for CS. Advances in medical treatment have helped reduce the

risk of stroke in patients with asymptomatic CS (3). Unlike other arterial stenosis (including in lower extremities and abdomen), it seems that carotid endarterectomy (CEA) for CS plays a favorable role even when compared to CAS in terms of overall risk of stroke or death (4). The recent guideline also considers the role of CEA as important (5).

Research pertaining to CS has largely focused on the appropriate selection from amongst the three main treatment modalities, i.e., medical treatment, CEA, and CAS. This is typically based on stroke risk stratification,

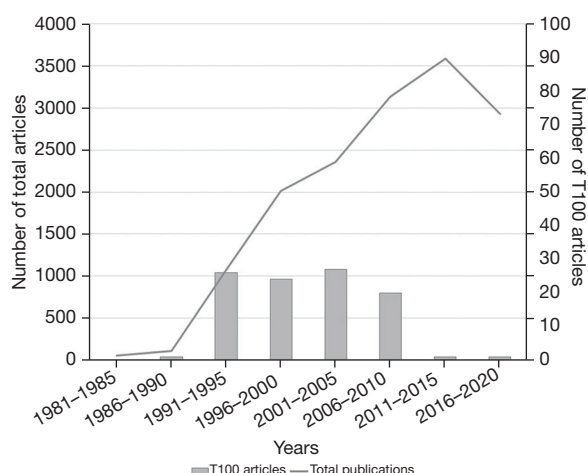


Figure 1 Temporal trend of the number of published articles on carotid stenosis. The line graph shows the overall number of articles published in each 5-year period. The bar graph shows the distribution of the top 100 cited articles (T100) in each 5-year period.

including assessing the symptoms, and the degree, of stenosis. Bibliometric analysis is a research method that aims to identify publication trends in a particular field with respect to authorship, journal, country, year of publication, and issues in a particular field (6). The purpose of this study was to analyze the performance and trends of CS research through bibliometric analysis.

Methods

Study design

Hallym University's Institutional Review Board (IRB No. HKS 2020-02-017) approved the review of medical article using a publicly available database. A search of the Thomson Reuters Web of Science citation indexing database and research platform was completed on August 22, 2019. The key words used in the search were “carotid artery” and “carotid stenosis”. The retrieved articles were filtered to include only full-text manuscripts published in the English language. The filtered manuscripts pertained only to the extracranial portion of the internal carotid artery.

Data collection and Statistical analysis

The retrieved manuscripts were sorted by the number of citations, a method initially developed by Paladugu and

colleagues (7). The two authors (H Jun and JW Hwang) analyzed the individual articles independently to ensure their relevance to CS. Any disagreements were resolved by consensus. The top 100 most cited articles (T100) were finally selected. The variables, including the title, corresponding author, institution, country of origin, year of publication, and topic, were then evaluated. All articles were analyzed according to their topic: CEA, medical treatment, CAS, diagnosis, and CEA *vs.* CAS. The “medical treatment” group included comparative studies between medical treatment and correction of stenosis by CEA or CAS. The “diagnosis” group included articles pertaining to manifestations, risk factors, clinical correlations with other diseases, and diagnostic tools (ultrasound, computed tomography, and magnetic resonance imaging). The “CEA *vs.* CAS” group included studies that compared the outcomes of CEA and CAS. Older articles are likely to be cited more frequently because more time has elapsed since publication; to eliminate this potential source of bias, the citation rate was analyzed by dividing the citation number by the number of years since publication.

Results

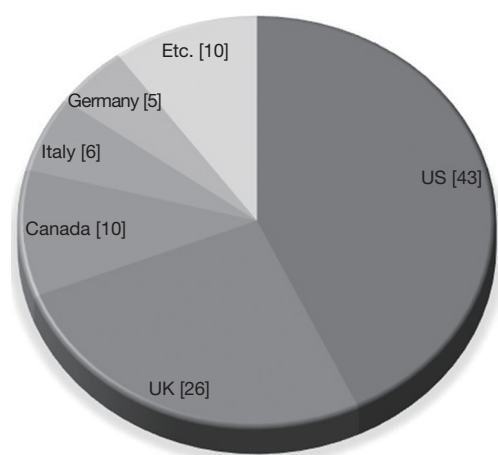
The authors retrieved 15,259 full-text English language papers from the Web of Science database. The T100 are listed in Table S1. The number of citations ranged from 5,424 for Barnett *et al.* (8) (“Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis”) to 230 for Mannami *et al.* (9) (“Prevalence of asymptomatic carotid atherosclerotic lesions detected by high-resolution ultrasonography and its relation to cardiovascular risk factors in the general population of a Japanese city: the Suita study”). The mean number of citations for all articles was 582.7 ± 707.7 .

The T100 were published between 1990 and 2016. Overall, the number of articles pertaining to CS showed a progressive increase over successive years; however, the T100 were distributed uniformly over this period (Figure 1). The oldest of the T100 was published in 1990 by Craven *et al.* (“Evaluation of the associations between carotid artery atherosclerosis and coronary artery stenosis. A case-control study”) (10). The most recent article was published in 2016 by Brott *et al.* (“Long-term results of stenting versus endarterectomy for carotid-artery stenosis”) (11).

The T100 were published across 20 journals (Table 1). *Stroke* published the highest number of papers ($n=22$, citations =7,669). The *New England Journal of Medicine* had

Table 1 Journals with three or more articles in the top 100 cited articles

Journal title	Impact factor 2018	5 years impact factor	Number or articles	Number of citations
<i>Stroke</i>	6.058	6.576	22	7,669
<i>Circulation</i>	23.054	20.469	18	7,428
<i>Lancet</i>	59.102	54.664	13	11,934
<i>New England Journal of Medicine</i>	70.67	70.331	10	15,113
<i>Journal of Vascular Surgery</i>	3.243	3.616	8	2,463
<i>Journal of the American Medical Association</i>	51.273	46.312	5	5,216
<i>Radiology</i>	7.608	8.282	5	1,972
<i>Lancet Neurology</i>	28.755	30.542	3	1,206
<i>Journal of the American College of Cardiology</i>	18.639	19.068	3	1,096

**Figure 2** Pie chart showing the distribution of the top 100 cited articles according to the country of origin.

the highest number of citations [15,113], although only 10 out of the T100 were published in this journal.

A vast majority of the T100 were published in the United States (43 publications) and United Kingdom (26 publications) (*Figure 2*), and most of the studies were performed in western countries. The University of Oxford had the highest number of publications among the T100 (seven publications) followed by the University of Washington (six publications) (*Table 2*). Eleven corresponding authors contributed to two or more papers; among these, Peter M. Rothwell had contributed to 10 publications (*Table 3*).

The articles were divided into the following categories according to the main topic (*Figure 3*): CEA (n=22), medical treatment (n=11), CAS (n=9), diagnosis (n=44), and CEA *vs.*

CAS (n=14). Only 2 of the T100 were published after 2011. Articles in the CEA group were consistently published over time; however, the number of publications tended to decrease over time. Most articles in the CAS groups were published between 1996 and 2005. Publications in the medical treatment group tended to increase over time. The diagnosis group continued to account for a significant proportion of articles and included four studies investigating the correlation with coronary artery disease. The number of studies in the CEA *vs.* CAS group showed a remarkable increase after 2006.

Discussion

CEA was introduced by DeBakey (12) in 1953; it has long been considered the standard therapy for CS requiring recanalization. Ever since the first CAS study was published by Kerber (13) in 1980, it is widely practiced as a viable alternative to CEA. Consistent with this, our study also revealed a consistent trend of published studies comparing CEA and CAS (*Figure 3*). Favorable results have been published for CEA, but similar results have recently been reported in the overall risk of stroke or death in patients with CS (4,11). Medical treatment trials for CS were initiated in the 1990s; the resultant advances in medical treatment have helped reduce the stroke risk in patients with CS (3). In recent trials (including SAMMPRIS trial), aggressive medical treatment (including antiplatelet and lipid management) was associated with decreased risk of stroke in patients with asymptomatic CS, regardless of recanalization (14). Despite advances in recanalization technology, medical treatment seems to play a more

Table 2 Institution with three or more articles in the top 100 cited articles

Institution	Number of publications	Total number of citations
University of Oxford	7	3,235
University of Washington	6	2,511
Wake Forest University	5	5,100
Western General Hospital	5	5,043
University College London	4	2,294
John P. Robarts Research Institute	3	3,485
St George Hospital	3	2,339
University of Western Ontario	3	864

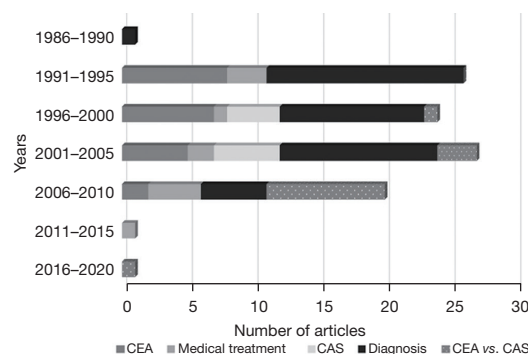
Table 3 Corresponding authors that contributed two or more articles to the top 100

Author	Number of articles	Total number of citations
Rothwell, P	10	4,005
Barnett, H	5	3,847
Yuan, C	5	1,834
Brown, M	4	2,294
Crouse, J	3	1,255
Taylor, D	2	5,787
Halliday, A	2	1,975
Brott, T	2	1,786
Oleary, D	2	1,122
Hatsukami, T	2	899
Wholey, M	2	705

important role in CS.

Recently, the endovascular approach is an important issue in vascular disease and has greatly improved. While the number of studies pertaining to CS has increased progressively over successive years, the temporal distribution of the T100 has remained mostly steady over a long period of time (*Figure 1*). This likely reflects the fact that modern treatment modalities for CS have not replaced traditional treatments completely. There are several ongoing historical studies of the comparative efficacy of CEA, CAS, and medical treatment.

Bibliometric analysis can help assess research performance, scientific productivity, and publication quality (15). The

**Figure 3** Composite bar graph showing the distribution of the top 100 cited publications in each 5-year period according to the research topic. CEA, carotid endarterectomy; CAS, carotid artery angioplasty/stenting.

number of citations is a good indicator of the quality and impact of publications. In this study, we selected the T100 according to the number of citations. By analyzing the flow of past publications, bibliometric analysis can help predict future publication trends. Therefore, bibliometric analysis is a useful tool to understand the history of a particular field.

As with any bibliometric analysis, our results are liable to be affected by several potential sources of bias, including institutional bias and influential researcher bias. Moreover, older studies are more likely to be cited because more time has elapsed since publication; this is another source of potential bias. Lastly, we analyzed only the T100 and not all CS studies; therefore, we may not have assessed the overall study trends accurately.

Conclusions

This bibliometric analysis of CS research provides insight into publication trends and perspective on the treatment of CS. The main treatment modalities for CS include CEA, CAS, and medical treatment; these are viable treatment alternatives and may be used in conjunction with each other. Ongoing analysis of CS research is a key imperative.

Acknowledgments

Funding: None.

Footnote

Peer Review File: Available at <https://apm.amegroups.com/article/view/10.21037/apm-21-3420/prf>

Conflicts of Interest: Both authors have completed the ICMJE uniform disclosure form (available at <https://apm.amegroups.com/article/view/10.21037/apm-21-3420/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Hallym University's Institutional Review Board (IRB No. HKS 2020-02-017) approved the review of medical articles using a publicly available database.

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2. Abbott AL, Bladin CF, Levi CR, et al. What should we do with asymptomatic carotid stenosis? *Int J Stroke* 2007;2:27-39.
3. Abbott AL. Medical (nonsurgical) intervention alone is now best for prevention of stroke associated with asymptomatic severe carotid stenosis: results of a systematic review and analysis. *Stroke* 2009;40:e573-83.
4. Abbott AL, Adelman MA, Alexandrov AV, et al. Why calls for more routine carotid stenting are currently inappropriate: an international, multispecialty, expert review and position statement. *Stroke* 2013;44:1186-90.
5. Naylor AR, Ricco JB, de Borst GJ, et al. Editor's Choice – Management of atherosclerotic carotid and vertebral artery disease: 2017 Clinical Practical Guidelines of the European Society for Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2018;55:3-81.
6. Luukkonen T. Bibliometrics and evaluation of research performance. *Ann Med* 1990;22:145-50.
7. Paladugu R, Schein M, Gardezi S, et al. One hundred citation classics in general surgical journals. *World J Surg* 2002;26:1099-105.
8. North American Symptomatic Carotid Endarterectomy Trial Collaborators; Barnett HJM, Taylor DW, et al. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Engl J Med* 1991;325:445-53.
9. Mannami T, Konishi M, Baba S, et al. Prevalence of asymptomatic carotid atherosclerotic lesions detected by high-resolution ultrasonography and its relation to cardiovascular risk factors in the general population of a Japanese city: the Suita study. *Stroke* 1997;28:518-25.
10. Craven TE, Ryu JE, Espeland MA, et al. Evaluation of the associations between carotid artery atherosclerosis and coronary artery stenosis. A case-control study. *Circulation* 1990;82:1230-42.
11. Brott TG, Howard G, Roubin GS, et al. Long-Term Results of Stenting versus Endarterectomy for Carotid-Artery Stenosis. *N Engl J Med* 2016;374:1021-31.
12. DeBakey ME. Successful carotid endarterectomy for cerebrovascular insufficiency. Nineteen-year follow-up. *JAMA* 1975;233:1083-5.
13. Kerber CW, Cromwell LD, Loehden OL. Catheter dilatation of proximal carotid stenosis during distal bifurcation endarterectomy. *AJNR Am J Neuroradiol* 1980;1:348-9.
14. Derdeyn CP, Chimowitz MI, Lynn MJ, et al. Aggressive medical treatment with or without stenting in high-risk patients with intracranial artery stenosis (SAMMPRIS): the final results of a randomised trial. *Lancet* 2014;383:333-41.
15. Asghar I, Cang S, Yu H. Assistive technology for people with dementia: an overview and bibliometric study. *Health Info Libr J* 2017;34:5-19.

Cite this article as: Hwang JW, Jun H. Characteristics from the 100 most influential articles on carotid stenosis. *Ann Palliat Med* 2022. doi: 10.21037/apm-21-3420

Table S1 The top 100 cited articles on carotid stenosis

Rank	Article	Citations	Citation rate
1	Taylor DW. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. <i>N Engl J Med</i> 1991;325(7):445-53.	5,424	193.7
2	Walker MD, Marler JR, Goldstein M, et al. Endarterectomy for asymptomatic carotid-artery stenosis. <i>JAMA</i> 1995;273(18):1421-8.	3,568	148.7
3	Warlow C. MRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. European Carotid Surgery Trialists' Collaborative Group. <i>Lancet</i> 1991;337(8752):1235-43.	2,269	81
4	Barnett HJM, Taylor W, Eliasziw M, et al. Benefit of carotid endarterectomy in patients with symptomatic moderate or severe stenosis. <i>N Engl J Med</i> 1998;339(20):1415-25.	2,179	103.8
5	Farrell B, Fraser A, Sandercock P, et al. Randomised trial of endarterectomy for recently symptomatic carotid stenosis: final results of the MRC European carotid surgery trial (ECST). <i>Lancet</i> 1998;351(9113):1379-87.	1,990	94.8
6	Yadav JS, Wholey MH, Kuntz RE, et al. Protected carotid-artery stenting versus endarterectomy in high-risk patients. <i>N Engl J Med</i> 2004;351(15):1493-501.	1,807	120.5
7	Halliday A, Mansfield A, Marro J, et al. Prevention of disabling and fatal strokes by successful carotid endarterectomy in patients without recent neurological symptoms: randomised controlled trial. <i>Lancet</i> 2004;363(9420):1491-502.	1,568	104.5
8	Brott TG, Hobson RW, Howard G, et al. Stenting versus Endarterectomy for Treatment of Carotid-Artery Stenosis. <i>N Engl J Med</i> 2010;363(1):11-23.	1,555	172.8
9	Mas J, Chatellier G, Beyssen B, et al. Endarterectomy versus stenting in patients with symptomatic severe carotid stenosis. <i>N Engl J Med</i> 2006;355(16):1660-71.	1,032	79.4
10	Hobson RW, Weiss DG, Fields WS, et al. Efficacy of carotid endarterectomy for asymptomatic carotid stenosis. <i>N Engl J Med</i> 1993;328(4):221-7.	1,000	38.5
11	Selhub J, Jacques PF, Bostom AG, et al. Association between plasma homocysteine concentrations and extracranial carotid-artery stenosis. <i>N Engl J Med</i> 1995;332(5):286-91.	979	40.8
12	Ringleb PA, Allenberg J, Berger J, et al. 30 day results from the SPACE trial of stent-protected angioplasty versus carotid endarterectomy in symptomatic patients: a randomised non-inferiority trial. <i>Lancet</i> 2006;368(9543):1239-47.	967	74.4
13	Rothwell PM, Eliasziw M, Gutnikov SA, et al. Analysis of pooled data from the randomised controlled trials of endarterectomy for symptomatic carotid stenosis. <i>Lancet</i> 2003;361(9352):107-16.	962	60.1
14	Brown MM, Rogers J, Bland JM, et al. Endovascular versus surgical treatment in patients with carotid stenosis in the Carotid and Vertebral Artery Transluminal Angioplasty Study (CAVATAS): a randomised trial. <i>Lancet</i> 2001;357(9270):1729-37.	900	50
15	Rothwell PM, Eliasziw M, Gutnikov SA, et al. Endarterectomy for symptomatic carotid stenosis in relation to clinical subgroups and timing of surgery. <i>Lancet</i> 2004;363(9413):915-24.	867	57.8
16	Ederle J, Dobson J, Featherstone RL, et al. Carotid artery stenting compared with endarterectomy in patients with symptomatic carotid stenosis (International Carotid Stenting Study): an interim analysis of a randomised controlled trial. <i>Lancet</i> 2010;375(9719):985-97.	771	85.7
17	Crisby M, Nordin-Fredriksson G, Shah PK, et al. Pravastatin treatment increases collagen content and decreases lipid content, inflammation, metalloproteinases, and cell death in human carotid plaques- Implications for plaque stabilization. <i>Circulation</i> 2001;103(7):926-33.	765	42.5
18	Grant EG, Benson CB, Moneta GL, et al. Carotid artery stenosis: Gray-scale and Doppler US diagnosis-Society of Radiologists in Ultrasound consensus conference. <i>Radiology</i> 2003;229(2):340-6.	754	47.1

Table S1 (continued)

Table S1 (*continued*)

Rank	Article	Citations	Citation rate
19	Barnett HJM. North American Symptomatic Carotid Endarterectomy Trial. Methods, patient characteristics, and progress. <i>Stroke</i> 1991;22(6):711-20.	688	24.6
20	Mayberg MR, Wilson SE, Yatsu F, et al. Carotid endarterectomy and prevention of cerebral-ischemia in symptomatic carotid stenosis. <i>JAMA</i> 1991;266(23):3289-94.	677	24.2
21	Oleary DH, Polak JF, Kronmal RA, et al. Distribution and correlates of sonographically detected carotid-artery disease in the cardiovascular health study. <i>Stroke</i> 1992;23(12):1752-60.	669	24.8
22	Ferguson GG, Eliasziw M, Barr HWK, et al. The North American Symptomatic Carotid Endarterectomy Trial - Surgical results in 1415 patients. <i>Stroke</i> 1999;30(9):1751-8.	618	30.9
23	Tawakol A, Migrino RQ, Bashian GG, et al. In vivo F-18-fluorodeoxyglucose positron emission tomography imaging provides a noninvasive measure of carotid plaque inflammation in patients. <i>J Am Coll Cardiol</i> 2006;48(9):1818-24.	581	44.7
24	Yuan C, Mitsumori LM, Ferguson MS, et al. In vivo accuracy of multispectral magnetic resonance imaging for identifying lipid-rich necrotic cores and intraplaque hemorrhage in advanced human carotid plaques. <i>Circulation</i> 2001;104(17):2051-6.	522	29
25	Roubin GS, New G, Iyer SS, et al. Immediate and late clinical outcomes of carotid artery stenting in patients with symptomatic and asymptomatic carotid artery stenosis - A 5-year prospective analysis. <i>Circulation</i> 2001;103(4):532-7.	521	28.9
26	Craven TE, Ryu JE, Espeland MA, et al. Evaluation of the associations between carotid-artery atherosclerosis and coronary-artery stenosis - a case-control study. <i>Circulation</i> 1990;82(4):1230-42.	518	17.9
27	Yadav JS, Roubin GS, Iyer S, et al. Elective stenting of the extracranial carotid arteries. <i>Circulation</i> 1997;95(2):376-81.	513	23.3
28	Takaya N, Yuan C, Chu BC, et al. Association between carotid plaque characteristics and subsequent ischemic cerebrovascular events - A prospective assessment with MRI - Initial results. <i>Stroke</i> 2006;37(3):818-23.	485	37.3
29	Eckstein HH, Ringleb P, Allenberg JR, et al. Results of the Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) study to treat symptomatic stenoses at 2 years: a multinational, prospective, randomised trial. <i>Lancet Neurol</i> 2008;7(10):893-902.	477	43.4
30	Cai JM, Hastukami TS, Ferguson MS, et al. Classification of human carotid atherosclerotic lesions with in vivo multicontrast magnetic resonance imaging. <i>Circulation</i> 2002;106(11):1368-73.	472	27.8
31	Gurm HS, Yadav JS, Fayad P, et al. Long-term results of carotid stenting versus endarterectomy in high-risk patients. <i>N Engl J Med</i> 2008;358(15):1572-9.	467	42.5
32	Diethrich EB, Ndiaye M, Raid DB. Stenting in the carotid artery: Initial experience in 110 patients. <i>J Endovasc Surg</i> 1996;3(1):42-62.	459	20
33	Crouse JR, Byington RP, Bond MG, et al. Pravastatin, lipids, and atherosclerosis in the carotid arteries (PLAC-II). <i>Am J Cardiol</i> 1995;75(7):455-9.	455	19
34	Oleary DH, Polak JF, Wolfson SK, et al. Use of sonography to evaluate carotid atherosclerosis in the elderly - the cardiovascular health study. <i>Stroke</i> 1991;22(9):1155-63.	453	16.2
35	Asahara T, Bauters C, Pastore C, et al. Local-delivery of vascular endothelial growth-factor accelerates reendothelialization and attenuates intimal hyperplasia in balloon-injured rat carotid-artery. <i>Circulation</i> 1995;91(11):2793-801.	443	18.5
36	Markus HS, Droste DW, Kaps M, et al. Dual antiplatelet therapy with clopidogrel and aspirin in symptomatic carotid stenosis evaluated using Doppler embolic signal detection - The Clopidogrel and Aspirin for Reduction of Emboli in Symptomatic Carotid Stenosis (CARESS) trial. <i>Circulation</i> 2005;111(17):2233-40.	442	31.6

Table S1 (*continued*)

Table S1 (continued)

Rank	Article	Citations	Citation rate
37	Inzitari D, Eliasziw M, Gates P, et al. The causes and risk of stroke in patients with asymptomatic internal-carotid-artery stenosis. <i>N Engl J Med</i> 2000;342(23):1693-700.	439	23.1
38	Kastrup A, Groschel K, Krapf H, et al. Early outcome of carotid angioplasty and stenting with and without cerebral protection devices - A systematic review of the literature. <i>Stroke</i> 2003;34(3):813-9.	424	26.5
39	Hatsukami TS, Ross R, Polissar NL, et al. Visualization of fibrous cap thickness and rupture in human atherosclerotic carotid plaque in vivo with high-resolution magnetic resonance imaging. <i>Circulation</i> 2000;102(9):959-64.	414	21.8
40	Halliday A, Harrison M, Hayter E, et al. 10-year stroke prevention after successful carotid endarterectomy for asymptomatic stenosis (ACST-1): a multicentre randomised trial. <i>Lancet</i> 2010;376(9746):1074-84.	407	45.2
41	Liapis CD, Bell PRF, Mikhailidis D, et al. ESVS Guidelines. Invasive Treatment for Carotid Stenosis: Indications, Techniques. <i>Eur J Vasc Endovasc Surg</i> 2009;37:S1-S19.	403	40.3
42	Mathiesen EB, Bonna KH, Joakimsen O. Echolucent plaques are associated with high risk of ischemic cerebrovascular events in carotid stenosis - The Tromso Study. <i>Circulation</i> 2001;103(17):2171-5.	397	22.1
43	Hobson RW, Howard VJ, Roubin GS, et al. Carotid artery stenting is associated with increased complications in octogenarians: 30-day stroke and death rates in the CREST lead-in phase. <i>J Vasc Surg</i> 2004;40(6):1106-10.	389	25.9
44	Mas JL, Trinquart L, Leys D, et al. Endarterectomy Versus Angioplasty in Patients with Symptomatic Severe Carotid Stenosis (EVA-3S) trial: results up to 4 years from a randomised, multicentre trial. <i>Lancet Neurol</i> 2008;7(10):885-92.	379	34.5
45	Abbott AL. Medical (Nonsurgical) Intervention Alone Is Now Best for Prevention of Stroke Associated with Asymptomatic Severe Carotid Stenosis Results of a Systematic Review and Analysis. <i>Stroke</i> 2009;40(10):E573-E83.	373	37.3
46	Taylor DW, Barnett HJM, Haynes RB, et al. Low-dose and high-dose acetylsalicylic acid for patients undergoing carotid endarterectomy: a randomised controlled trial. <i>Lancet</i> 1999;353(9171):2179-84.	363	18.2
47	Wholey MH, Wholey M, Mathias K, et al. Global experience in cervical carotid artery stent placement. <i>Catheter Cardiovasc Interv</i> 2000;50(2):160-7.	359	18.9
48	Wennberg DE, Lucas FL, Birkmeyer JD, et al. Variation in carotid endarterectomy mortality in the Medicare population - Trial hospitals, volume, and patient characteristics. <i>JAMA</i> 1998;279(16):1278-81.	354	16.9
49	Bonati LH, Jongen LM, Haller S, et al. New ischaemic brain lesions on MRI after stenting or endarterectomy for symptomatic carotid stenosis: a substudy of the International Carotid Stenting Study (ICSS). <i>Lancet Neurol</i> 2010;9(4):353-62.	350	38.9
50	Wholey MH, Al-Mubarek N, Wholey MH. Updated review of the global carotid artery stent registry. <i>Catheter Cardiovasc Interv</i> 2003;60(2):259-66.	346	21.6
51	Moneta GL, Edwards JM, Papanicolaou G, et al. Screening for asymptomatic internal carotid artery stenosis: duplex criteria for discriminating 60% to 99% stenosis. <i>J Vasc Surg</i> 1995;21(6):989-94.	341	13.1
52	Gronholdt MLM, Nordestgaard BG, Schroeder TV, et al. Ultrasonic echolucent carotid plaques predict future strokes. <i>Circulation</i> 2001;104(1):68-73.	339	18.8
53	Naylor AR, Bolia A, Abbott RJ, et al. Randomized study of carotid angioplasty and stenting versus carotid endarterectomy: A stopped trial. <i>J Vasc Surg</i> 1998;28(2):326-34.	336	16
54	Norris JW, Zhu CZ, Bornstein NM, et al. Vascular risks of asymptomatic carotid stenosis. <i>Stroke</i> 1991;22(12):1485-90.	335	12
55	Silvestrini M, Vernieri F, Pasqualetti P, et al. Impaired cerebral vasoreactivity and risk of stroke in patients with asymptomatic carotid artery stenosis. <i>JAMA</i> 2000;283(16):2122-7.	332	17.5

Table S1 (continued)

Table S1 (continued)

Rank	Article	Citations	Citation rate
56	Adams MR, Nakagomi A, Keech A, et al. Carotid intima-media thickness is only weakly correlated with the extent and severity of coronary-artery disease. <i>Circulation</i> 1995;92(8):2127-34.	332	13.8
57	Markus H, Cullinane M. Severely impaired cerebrovascular reactivity predicts stroke and TIA risk in patients with carotid artery stenosis and occlusion. <i>Brain</i> 2001;124:457-67.	329	18.3
58	Theron JG, Payelle GG, Coskun O, et al. Carotid artery stenosis: Treatment with protected balloon angioplasty and stent placement. <i>Radiology</i> 1996;201(3):627-36.	323	14
59	Fox AJ. How to measure carotid stenosis. <i>Radiology</i> 1993;186(2):316-8.	323	12.4
60	Redgrave JNE, Lovett JK, Gallagher PJ, et al. Histological assessment of 526 symptomatic carotid plaques in relation to the nature and timing of ischemic symptoms - The Oxford plaque study. <i>Circulation</i> 2006;113(19):2320-8.	322	24.8
61	Carr S, Farb A, Pearce WH, et al. Atherosclerotic plaque rupture in symptomatic carotid artery stenosis. <i>J Vasc Surg</i> 1996;23(5):755-65.	322	14
62	Chaturvedi S, Bruno A, Feasby T, et al. Carotid endarterectomy - An evidence-based review - Report of the therapeutics and technology assessment subcommittee of the American Academy of Neurology. <i>Neurology</i> 2005;65(6):794-801.	316	22.6
63	Blankenhorn DH, Selzer RH, Crawford DW, et al. Beneficial effects of colestipol-niacin therapy on the common carotid artery. Two- and four-year reduction of intima-media thickness measured by ultrasound. <i>Circulation</i> 1993;88(1):20-8.	314	12.1
64	Yuan C, Mitsumori LM, Beach KW, et al. Carotid atherosclerotic plaque: Noninvasive MR characterization and identification of vulnerable lesions. <i>Radiology</i> 2001;221(2):285-99.	312	17.3
65	Biasi GM, Froio A, Diethrich EB, et al. Carotid plaque echolucency increases the risk of stroke in carotid stenting - The Imaging in Carotid Angioplasty and Risk of Stroke (ICAROS) study. <i>Circulation</i> 2004;110(6):756-62.	301	20.1
66	Lewis SC, Warlow CP, Bodenham AR, et al. General anaesthesia versus local anaesthesia for carotid surgery (GALA): a multicentre, randomised controlled trial. <i>Lancet</i> 2008;372(9656):2132-42.	300	27.3
67	Eliasziw M, Streifler JY, Fox AJ, et al. Significance of plaque ulceration in symptomatic patients with high-grade carotid stenosis. <i>Stroke</i> 1994;25(2):304-8.	298	11.9
68	Rothwell PM, Warlow CP, European Carotid Surg Trialists Collaborative G. Prediction of benefit from carotid endarterectomy in individual patients: a risk-modelling study. <i>Lancet</i> 1999;353(9170):2105-10.	297	14.9
69	Moody AR, Murphy RE, Morgan PS, et al. Characterization of complicated carotid plaque with magnetic resonance direct thrombus imaging in patients with cerebral ischemia. <i>Circulation</i> 2003;107(24):3047-52.	294	18.4
70	Golledge J, McCann M, Mangan S, et al. Osteoprotegerin and osteopontin are expressed at high concentrations within symptomatic carotid atherosclerosis. <i>Stroke</i> 2004;35(7):1636-41.	292	15.4
71	Gray WA, Hopkins LN, Yadav S, et al. Protected carotid stenting in high-surgical-risk patients: The ARChER results. <i>J Vasc Surg</i> 2006;44(2):258-68.	290	22.3
72	Marquardt L, Geraghty OC, Mehta Z, et al. Low Risk of Ipsilateral Stroke in Patients with Asymptomatic Carotid Stenosis on Best Medical Treatment A Prospective, Population-Based Study. <i>Stroke</i> 2010;41(1):E11-E7.	286	31.8
73	Spagnoli LG, Mauriello A, Sangiorgi G, et al. Extracranial thrombotically active carotid plaque as a risk factor for ischemic stroke. <i>JAMA</i> 2004;292(15):1845-52.	285	19
74	Crouse JR, Craven TE, Hagaman AP, et al. Association of coronary-disease with segment-specific intimal-medial thickening of the extracranial carotid-artery. <i>Circulation</i> 1995;92(5):1141-7.	282	11.8

Table S1 (continued)

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Rank	Article	Citations	Citation rate
75	Rothwell PM, Gutnikov SA, Warlow CP, et al. Reanalysis of the final results of the European Carotid Surgery Trial. <i>Stroke</i> 2003;34(2):514-23.	279	17.4
76	Wofford JL, Kahl FR, Howard GR, et al. Relation of extent of extracranial carotid-artery atherosclerosis as measured by b-mode ultrasound to the extent of coronary atherosclerosis. <i>Arterioscler Thromb</i> 1991;11(6):1786-94.	277	9.9
77	Ricotta JJ, AbuRahma A, Ascher E, et al. Updated Society for Vascular Surgery guidelines for management of extracranial carotid disease. <i>J Vasc Surg</i> 2011;54(3):E1-E31.	275	34.4
78	Bonati LH, Dobson J, Algra A, et al. Short-term outcome after stenting versus endarterectomy for symptomatic carotid stenosis: a preplanned meta-analysis of individual patient data. <i>Lancet</i> 2010;376(9746):1062-73.	273	30.3
79	Yuan C, Kerwin WS, Ferguson MS, et al. Contrast-enhanced high resolution MRI for atherosclerotic carotid artery tissue characterization. <i>J Magn Reson Imaging</i> 2002;15(1):62-7.	267	15.7
80	McCarthy MJ, Loftus IM, Thompson MM, et al. Angiogenesis and the atherosclerotic carotid plaque: An association between symptomatology and plaque morphology. <i>J Vasc Surg</i> 1999;30(2):261-8.	265	13.3
81	Brooks WH, McClure RR, Jones MR, et al. Carotid angioplasty and stenting versus carotid endarterectomy: Randomized trial in a community hospital. <i>J Am Coll Cardiol</i> 2001;38(6):1589-95.	263	14.6
82	Chu BC, Kampschulte A, Ferguson MS, et al. Hemorrhage in the atherosclerotic carotid plaque: A high-resolution MRI study. <i>Stroke</i> 2004;35(5):1079-84.	261	17.4
83	Polak JF, Shemanski L, O'Leary DH, et al. Hypoechoic plaque at US of the carotid artery: An independent risk factor for incident stroke in adults aged 65 years or older. <i>Radiology</i> 1998;208(3):649-54.	260	12.4
84	Rothwell PM, Slattery J, Warlow CP. Clinical and angiographic predictors of stroke and death from carotid endarterectomy: systematic review. <i>Bmj-British Medical Journal</i> 1997;315(7122):1571-7.	259	11.8
85	Sitzer M, Muller W, Siebler M, et al. Plaque ulceration and lumen thrombus are the main sources of cerebral microemboli in high-grade internal carotid-artery stenosis. <i>Stroke</i> 1995;26(7):1231-3.	258	10.8
86	Bots ML, Hofman A, Grobbee DE. Increased common carotid intima-media thickness - Adaptive response or a reflection of atherosclerosis? Findings from the Rotterdam study. <i>Stroke</i> 1997;28(12):2442-7.	256	11.6
87	Tang TY, Howarth SPS, Miller SR, et al. The ATHEROMA (Atorvastatin Therapy: Effects on Reduction of Macrophage Activity) Study Evaluation Using Ultrasmall Superparamagnetic Iron Oxide-Enhanced Magnetic Resonance Imaging in Carotid Disease. <i>J Am Coll Cardiol</i> 2009;53(22):2039-50.	252	25.2
88	Rothwell PM, Gibson R, Warlow CP, et al. Interrelation between plaque surface morphology and degree of stenosis on carotid angiograms and the risk of ischemic stroke in patients with symptomatic carotid stenosis. <i>Stroke</i> 2000;31(3):615-21.	249	13.1
89	Prati P, Vanuzzo D, Casaroli M, et al. Prevalence and determinants of carotid atherosclerosis in a general-population. <i>Stroke</i> 1992;23(12):1705-11.	247	9.1
90	Rothwell PM, Slattery J, Warlow CP. Systematic review of the risks of stroke and death due to endarterectomy for symptomatic carotid stenosis. <i>Stroke</i> 1996;27(2):260-5.	246	10.7
91	Riles TS, Imparato AM, Jacobowitz GR, et al. The cause of perioperative stroke after carotid endarterectomy. <i>J Vasc Surg</i> 1994;19(2):206-16.	245	9.8
92	Henderson RD, Eliasziw M, Fox AJ, et al. Angiographically defined collateral circulation and risk of stroke in patients with severe carotid artery stenosis. <i>Stroke</i> 2000;31(1):128-32.	243	12.8
93	Diener HC. Carotid surgery versus medical therapy in asymptomatic carotid stenosis. <i>Stroke</i> 1991;22(10):1229-35.	241	8.6

Table S1 (continued)

Table S1 (*continued*)

Rank	Article	Citations	Citation rate
94	Bonora E, Kiechl S, Willeit J, et al. Carotid atherosclerosis and coronary heart disease in the metabolic syndrome: prospective data from the Bruneck study. <i>Diabetes Care</i> 2003;26(4):1251-7.	239	14.9
95	Rothwell PM, Gibson RJ, Slattery J, et al. equivalence of measurements of carotid stenosis-a comparison of 3 methods on 1001 angiograms. <i>Stroke</i> 1994;25(12):2435-9.	238	9.5
96	Moore WS, Barnett HJM, Beebe HG, et al. Guidelines for carotid endarterectomy - a multidisciplinary consensus statement from the ad-hoc-committee, American-heart-association. <i>Circulation</i> 1995;91(2):566-79.	237	9.9
97	Trivedi RA, Mallawarachi C, U-King-Im JM, et al. Identifying inflamed carotid plaques using in vivo USPIO-enhanced MR imaging to label plaque macrophages. <i>Arterioscler Thromb Vasc Biol</i> 2006;26(7):1601-6.	235	18.1
98	Fineedelstein JS, Wolf PA, O'leary DH, et al. Precursors of extracranial carotid atherosclerosis in the Framingham-study. <i>Neurology</i> 1994;44(6):1046-50.	232	9.3
99	Brott TG, Howard G, Roubin GS, et al. Long-Term Results of Stenting versus Endarterectomy for Carotid-Artery Stenosis. <i>N Engl J Med</i> 2016;374(11):1021-31.	231	77
100	Mannami T, Konishi M, Baba S, et al. Prevalence of asymptomatic carotid atherosclerotic lesions detected by high-resolution ultrasonography and its relation to cardiovascular risk factors in the general population of a Japanese city - The Suita study. <i>Stroke</i> 1997;28(3):518-25.	230	10.5