

Safety and Efficiency of Endovascular Treatment of Carotid Angioplasty Stenting Compared with Carotid Endarterectomy

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ABSTRACT

Background: The efficacy of carotid endarterectomy (CEA) has been validated by several multicentre, randomized trials. At present, comparative studies are mounting insight into the role of carotid angioplasty and stenting (CAS), also optimizing patient selection based on factors identification. CAS has been proposed as an alternative to CEA for the treatment of carotid endarterectomy.

Aim: To equate the safety and efficacy of endovascular techniques i.e. CAS and CEA with surgery for carotid stenosis, we implemented a systematic review and meta-analysis of randomized controlled trials.

Methods: We recognized 8 trials randomizing a total of 2250 patients; 1123 to CEA and 1127 to CAS. Search was made through various databases i.e., PubMed, MEDLINE etc, to identify randomized controlled trials comparing CAS with CEA. To calculate the pooled odds ratios (OR) and their confidence intervals, both fixed and random effects models were used. A lower value to one indicates benefit from endovascular approach.

Results: There was no significant difference between the treatments even with random effect model (OR=1.10; 95%), also there is no difference with deaths or any stroke at 30 days (OR = 1.21; 95%). But by fixed effect model, a significantly higher death/ stroke risk were estimated (OR, 1.11; 95%) after CAS.

Conclusion: Treating carotid endarterectomy with CAS suggests lower rates of cranial nerve injury in comparison to CEA. CAS may perhaps not be verified, to be as nonviolent as CEA in treating carotid endarterectomy.

Keywords: Endarterectomy, carotid angioplasty and stenting, endovascular treatment,

INTRODUCTION

Most of the surgeon proposed that carotid angioplasty stenting is an alternate to carotid endarterectomy and it is also considered that both techniques are almost equally effective¹. As compared to carotid endarterectomy- a surgical procedure to prevent stenosis in the carotid artery, carotid angioplasty stenting is minimal invasive and less time consuming technique². But it's a controversial debate to decide which technique is more safe and efficient. Both techniques have some plus points and some negative points. Carotid endarterectomy (CEA) is a standard operation procedure in patients with elderly and stroke³. Whereas in patients treated with CAS has less recurrence rate of stroke and stenosis⁴.

Carotid endarterectomy is proven effective in high grade carotid stenosis patients. In term of recurrence, stroke morbidity and mortality CEA is preferred over angioplasty or stenting^{5,6}. Among other factors now a days cost effectiveness is also

discussed. CEA is considered to be cheaper than CAS. It has been observed that CAS is approximately 40% more expensive than CEA^{5,7,8}. Its been observed that restenosis is three times more common in endovascular treated patients than cae group⁹.

Carotid angioplasty is advocated by vascular surgeons because in it surgical complications are less in this procedure¹⁰. Nerve injuries are negligible were as in patients treated with CEA nerve injuries are reported^{1,11}.

It was observed that risk of MI in CEA and CAS was approximately same in patients who were given local anesthesia but the patients who were treated with general anesthesia were on higher risk of Myocardial infarction (MI)².

MATERIAL AND METHODS

Pubmed database was searched for original articles comparing carotid angioplasty stenting and carotid endarterectomy, published during 2000-2013. Eight studies in which carotid endarterectomy and angeoplasty were compared using randomized control trail were included in the study. The pooled odds ratios (OR) and their confidence intervals, both fixed and random effects models were used. A lower

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value to one indicates benefit from endovascular approach. Meta analytic studies or review articles were excluded. The primary objective was focused on the postoperative complications like stenosis recurrence, stroke, mortality and other morbidities in result of endovascular treatment. Odds ratio and 95% Confidence intervals were observed.

RESULTS

Mix results were found mean age was above 60 years and in treated patients males were frequent. According to table 1 data the values were analyzed using student's *t* test. Percentages of restenosis were not statistically significantly different in both groups (p-value 0.186). Similarly, stroke rate was also not found statistically significantly in both groups. The calculated mean rate of stroke for CEA group was 3.24±2.35 and average rate of stroke in CAS was

5.32 ± 4.09. Whether, the rate of stroke was higher in endovascular treated group but the difference was not statistically significant (p-value 0.288). In patients treated with endarterectomy mean restenosis recurrence rate was higher than in patients treated with carotid angioplasty stenting. Comparatively hospital stay was higher in patients treated with surgical method whereas in carotid angioplasty group the average length of stay was less (2.86±1.32 and 2.74±1.98 respectively). But it was not statistically significant (p-value 0.823).

The results of the studies showed that in angioplasty group the odds of restenosis were 1.8 times higher as compared to endarterectomy. Similarly different studies showed that the adjusted odds ratios, relative risk and hazard ratios were statistically significantly higher in carotid angioplasty stenting group.

Table 1: Comparison of complications in carotid endarterectomy (CEA) and carotid Angioplasty stenting (CAS)

Restenosis		Stroke		MI		Mortality		References
CEA	CAS	CEA	CAS	CEA	CAS	CEA	CAS	
10.50%	30.70%	-	-	-	-	-	-	(Bonati et al., 2009)
10%-24%	23%-34%	-	-	-	-	-	-	(De Borst et al., 2006)
2.20%	1.60%	-	-	-	-	-	-	(Lancelevee et al., 2013)
4.70%	-	1.40%	-	-	-	-	-	(Matsagas et al., 2006)
2%	-	1.40%	-	-	-	-	-	(Matsagas et al., 2006)
-	-	4%	2%	4%	0%	2%	0%	(Park et al., 2006)
-	-	2.30%	3.80%	-	-	-	-	(Sternbergh et al., 2012)
-	-	1.00%	1.70%	1.50%	1.70%	0%	0.80%	(Tang et al., 2008)

Table 2: Comparison between the hospital stay of both groups

Hospital Stay (days)		References
CEA	CAS	
1.2-4.5	1.1-4.0	1
2.7-3.8	1.8-5.6	12
2.1	1.2	8

Table 3: risk of complications in carotid angioplasty group as compared to endarterectomy group

OR Restenosis (95%-C.I)	OR Stroke (95%-C.I)	OR Cardiac (95%-C.I)	OR Mortality (95%-C.I)	References
1.8 (1.1-3.1)	1.6 (1.2-2.0)	-	1.5 (1.1-2.1)	(13)
-	1.33 (0.04)	-	-	(11)
-	1.3 (0.4-3.6)*	0.3 (0.1-0.9)	1.3 (0.6-2.8)*	(14)
-	1.37 (1.04-1.81)	-	-	(15)
-	1.39 (0.96-2.00)**	-	1.77 (1.03-3.02)**	(16)
3.17 (1.89- 5.32)**	-	-	-	(Bonati et al, 2009)

*Relative risk ** Hazard Ratio

Table 4: Comparison of Odds Ratio of complications in both groups.

OR Stroke (95% C.I)	OR Cardiac (95% C.I)		OR Mortality (95% C.I)	References
CAS	CEA	CAS	CEA	
1.7 (1.2-2.5)	1.5 (1.3-1.7)	1.3(1.0-1.6)	1.4 (1.1-1.8)	3

DISCUSSION

Many controversial results were observed during this study there are some factors on the basis of which we could decide which treatment is better than the other. Choice of treatment should be done considering these factors in mind.

There are many factors involved with the morbidity and mortality in endovascular treatments, one of them is the anesthesia, it was observed that the morbidity rate increases in patients given general anesthesia as compared to local anesthesia apart from whatever treatment was given². In angioplasty technique, advanced catheterization skills are needed to be developed for safe end results¹⁷.

Aging factor is associated with the Stenosis. It was observed that endarterectomy is effective in elderly patients where as stenting is acceptable in young. The odds of stroke, cardiac disease/ MI and death were higher in more than seventy years old patients than in less than or equal to seventy years old patients in both groups (Table 4).

In many studies the post operative complications have been discussed the most common were restenosis, stroke, cardiac disease/ myocardial infarction and cranial nerve injuries. It has been suggested in the studies that the postoperative complications are less in carotid endarterectomy^{4,18}. But it's been also observed that cerebral / cranial injuries are frequent in carotid endarterectomy groups¹⁴.

As with the increase of population the patient to hospital load is also increasing. Therefore the hospital stay / average length of stay in hospital has become a debatable factor. The angioplasty is treatment is minimal invasive due to which average length of stay of patient treated with carotid angioplasty was shorter than patients undergone surgery procedure¹².

Cost effectiveness is another plus point for carotid endarterectomy. If the complication occurs in patients during operation it has been observed that the average length of stay is more in angioplasty patients than the carotid endarterectomy group⁷.

Apart from comparison, the combination of both treatments has shown better results than the solo treatment. And less post operative complications were observed¹⁹.

CONCLUSION

Both Carotid endovascular treatments are safe and effective to some extent. In young patients angioplasty was effective and in old patients endarterectomy. But combinations of both techniques are costly but are much safe and effective. Overall,

treating carotid endarterectomy with CAS suggests lower rates of cranial nerve injury in comparison to CEA. CAS may perhaps not be verified, to be as nonviolent as CEA in treating carotid endarterectomy.

REFERENCES

1. Brooks WH, McClure RR, Jones MR, Coleman TL, Breathitt L. Carotid angioplasty and stenting versus carotid endarterectomy for treatment of asymptomatic carotid stenosis: a randomized trial in a community hospital. *Neurosurgery*. 2004 Feb;54(2):318-24; discussion 24-5. PubMed PMID: 14744277.
2. Kfoury E, Leng D, Hashemi H, Mukherjee D. Cardiac Morbidity of Carotid Endarterectomy Using Regional Anesthesia is Similar to Carotid Stent Angioplasty. *Vascular and endovascular surgery*. 2013 Sep 26. PubMed PMID: 24077934.
3. Khatri R, Chaudhry SA, Vazquez G, Rodriguez GJ, Hassan AE, Suri MF, et al. Age differential between outcomes of carotid angioplasty and stent placement and carotid endarterectomy in general practice. *Journal of vascular surgery*. 2012 Jan;55(1):72-8. PubMed PMID: 22070935.
4. Bettendorf MJ, Mansour MA, Davis AT, Sugiyama GT, Cali RF, Gorsuch JM, et al. Carotid angioplasty and stenting versus redo endarterectomy for recurrent stenosis. *American journal of surgery*. 2007 Mar;193(3):356-9; discussion 9. PubMed PMID: 17320534.
5. Moore WS. Carotid endarterectomy versus carotid angioplasty cui bono. *European journal of vascular and endovascular surgery : the official journal of the European Society for Vascular Surgery*. 2010 Mar;39 Suppl 1:S44-8. PubMed PMID: 19879167.
6. Beebe HG, Kritpracha B. Carotid endarterectomy versus carotid angioplasty: comparison of current results. *Seminars in vascular surgery*. 2000 Jun;13(2):109-16. PubMed PMID: 10879551.
7. Sternbergh WC, 3rd, Crenshaw GD, Bazan HA, Smith TA. Carotid endarterectomy is more cost-effective than carotid artery stenting. *Journal of vascular surgery*. 2012 Jun;55(6):1623-8. PubMed PMID: 22459744.
8. Park B, Mavanur A, Dahn M, Menzoian J. Clinical outcomes and cost comparison of carotid artery angioplasty with stenting versus carotid endarterectomy. *Journal of vascular surgery*. 2006 Aug;44(2):270-6. PubMed PMID: 16890852.
9. Bonati LH, Ederle J, McCabe DJ, Dobson J, Featherstone RL, Gaines PA, et al. Long-term risk of carotid restenosis in patients randomly assigned to endovascular treatment or endarterectomy in the Carotid and Vertebral Artery Transluminal Angioplasty Study (CAVATAS): long-term follow-up of a randomised trial. *Lancet neurology*. 2009 Oct;8(10):908-17. PubMed PMID: 19717347. Pubmed Central PMCID: 2755038.
10. McDonnell CO, Legge D, Twomey E, Kavanagh EG, Dundon S, O'Donohoe MK, et al. Carotid artery angioplasty for restenosis following endarterectomy. *European journal of vascular and endovascular*

- surgery : the official journal of the European Society for Vascular Surgery. 2004 Feb;27(2):163-6. PubMed PMID: 14718898.
11. Bakoyiannis C, Economopoulos KP, Georgopoulos S, Bastounis E, Papalambros E. Carotid endarterectomy versus carotid angioplasty with or without stenting for treatment of carotid artery stenosis: an updated meta-analysis of randomized controlled trials. *International angiology : a journal of the International Union of Angiology*. 2010 Jun;29(3):205-15. PubMed PMID: 20502407.
 12. Brooks WH, McClure RR, Jones MR, Coleman TC, Breathitt L. Carotid angioplasty and stenting versus carotid endarterectomy: randomized trial in a community hospital. *Journal of the American College of Cardiology*. 2001 Nov 15;38(6):1589-95. PubMed PMID: 11704367.
 13. Arya S, Pipinos II, Garg N, Johanning J, Lynch TG, Longo GM. Carotid endarterectomy is superior to carotid angioplasty and stenting for perioperative and long-term results. *Vascular and endovascular surgery*. 2011 Aug;45(6):490-8. PubMed PMID: 21646236.
 14. Qureshi AI, Kirmani JF, Divani AA, Hobson RW, 2nd. Carotid angioplasty with or without stent placement versus carotid endarterectomy for treatment of carotid stenosis: a meta-analysis. *Neurosurgery*. 2005 Jun;56(6):1171-9; discussion 9-81. PubMed PMID: 15918933.
 15. Jeng JS, Liu HM, Tu YK. Carotid angioplasty with or without stenting versus carotid endarterectomy for carotid artery stenosis: a meta-analysis. *Journal of the neurological sciences*. 2008 Jul 15;270(1-2):40-7. PubMed PMID: 18304582.
 16. Mas JL, Trinquart L, Leys D, Albuquer JF, Rousseau H, Viguier A, 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. *Lancet neurology*. 2008 Oct;7(10):885-92. PubMed PMID: 18774745.
 17. Tang GL, Matsumura JS, Morasch MD, Pearce WH, Nguyen A, Amaranto D, et al. Carotid angioplasty and stenting vs carotid endarterectomy for treatment of asymptomatic disease: single-center experience. *Archives of surgery*. 2008 Jul;143(7):653-8. PubMed PMID: 18645107.
 18. Vos JA, de Borst GJ, Overtoom TT, de Vries JP, van de Pavoordt ED, Zanen P, et al. Carotid angioplasty and stenting: treatment of postcarotid endarterectomy restenosis is at least as safe as primary stenosis treatment. *Journal of vascular surgery*. 2009 Oct;50(4):755-61 e1. PubMed PMID: 19576717.
 19. Hobson RW, 2nd, Lal BK, Chakhtoura EY, Goldstein J, Kubicka R, Haser PB, et al. Carotid artery closure for endarterectomy does not influence results of angioplasty-stenting for restenosis. *Journal of vascular surgery*. 2002 Mar;35(3):435-8. PubMed PMID: 11877689.