

# Protection and Effectiveness of Carotid Angioplasty Stenting Compared with Carotid Endarterectomy

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## ABSTRACT

**Aim:** To compare the beneficial role of carotid angioplasty in comparison to carotid endarterectomy.

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

**Results:** Mixed results were found in literature. The mean age was above 60 years and most of the patients were male. Percentages of restenosis were not significantly different statistically in both groups ( $p=0.186$ ). The calculated mean rate of stroke for CEA group was  $3.24\pm 2.35$  and average rate of stroke in CAS was  $5.32\pm 4.09$ . The average length of stay was  $2.86\pm 1.32$  and  $2.74\pm 1.98$  ( $p=0.823$ ). The results of the studies have shown that in angioplasty group the odds of restenosis were 1.8 times higher as compared to endarterectomy.

**Conclusion:** Both Carotid endovascular treatments are safe and effective to some extent. CAS may perhaps not be verified, to be as nonviolent as CEA in treating carotid endarterectomy.

**Keywords:** Carotid angioplasty, carotid endarterectomy, odds ratio, confidence interval

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## INTRODUCTION

Most of the surgeon proposed that carotid angioplasty stenting is an alternate to carotid endarterectomy. It is also considered that both techniques are almost equally effective<sup>1</sup>. As compared to carotid endarterectomy, carotid angioplasty stenting is a surgical procedure to prevent stenosis in the carotid artery. CAS is minimal invasive and less time consuming technique<sup>2</sup>. However, it is debatable 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 stroke<sup>3</sup>. Whereas the patients treated with CAS have less recurrence rate of stroke and stenosis<sup>4</sup>.

Carotid endarterectomy is proven effective in high graded carotid stenosis patients. In term of recurrence, stroke morbidity and mortality CEA is preferred over angioplasty or stenting<sup>5,6</sup>. Among other factors, nowadays, cost effectiveness is also an issue to be considered. CEA is considered to be cheaper than CAS. It has been observed that CAS is approximately 40% more expensive than CEA<sup>5,7,8</sup>. Furthermore, it has been observed that restenosis is three times more common in endovascular treated patients than CEA group<sup>9</sup>.

Due to less surgical complications in Carotid angioplasty, it has been advocated by vascular surgeons<sup>10</sup>. Nerve injuries are negligible whereas in patients treated with CEA nerve injuries are reported<sup>11</sup>.

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

## MATERIAL AND METHODS

Pub Med database was searched for articles comparing carotid angioplasty stenting and carotid endarterectomy, published during 2000-2013. Eight studies in which carotid endarterectomy and angioplasty were compared using randomized control trial were included in the study. The pooled odds ratios (OR) and their confidence intervals, both fixed and random effects models were used. A value less than one indicate benefit from endovascular approach. Meta-analytic studies or review articles were excluded. The primary objective was focused on the post-operative complications like stenosis recurrence, stroke, mortality and other morbidities in view of endovascular treatment. Odds ratio and 95% Confidence intervals were observed.

## RESULTS

Mixed results were found in literature. The mean age was above 60 years and most of the patients were male. An over view of comparison of complications in carotid endarterectomy (CEA) and carotid Angioplasty stenting (CAS) is given in table 1.

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According to table 1, the data values were analyzed using student t test. Percentages of restenosis were not significantly different statistically in both groups (p-value 0.186). Similarly, the stroke rate was not found statistically significant in both groups. The calculated mean rate of stroke for CEA group was  $3.24 \pm 2.35$  and average rate of stroke in CAS was  $5.32 \pm 4.09$ . The rate of stroke was higher in endovascular treated group but the difference was not statistically significant (p-value 0.288). For the patients treated with endarterectomy, mean restenosis recurrence rate was higher than the patients treated with carotid angioplasty stenting (Table 2).

Moreover, the hospital stay was higher for the patients treated with surgical method as compared to carotid angioplasty. The average length of stay was  $2.86 \pm 1.32$  and  $2.74 \pm 1.98$ , respectively. However, it was not statistically significant (p-value 0.823) (Table 3). The results of the studies have shown that in angioplasty group the odds of restenosis were 1.8 times higher as compared to endarterectomy. Similarly, different studies have shown that the adjusted odds ratios, relative risk and hazard ratios were significantly higher statistically in carotid angioplasty stenting group.

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

Restenosis		Stroke		MI		Mortality		
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%	-	-	-	-	-	-	(Lanceveve 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)		Reference
CEA	CAS	
1.2-4.5	1.1-4.0	( Brooks et al., 2004)
2.7-3.8	1.8-5.6	( Brooks et al., 2001)
2.1	1.2	( Park et al., 2006 )

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)	Reference
1.8 (1.1-3.1)	1.6 (1.2-2.0)	-	1.5 (1.1-2.1)	(Arya et al., 2011)
-	1.33 (0.04)	-	-	( Bakoyiannis et al., 2010)
-	1.3 (0.4-3.6)*	0.3 (0.1-0.9)	1.3 (0.6-2.8)*	( Qureshi et al., 2005)
-	1.37 (1.04-1.81)	-	-	( Jeng et al., 2008)
-	1.39 (0.96-2.00)**	-	1.77 (1.03-3.02)**	( Mas et al., 2008)
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)	Reference
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)	( Khatri et al., 2012)

## DISCUSSION

The observed results found during this study are debatable. However, based on some factors we can compare and decide which treatment is better than the other. The 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 given<sup>2</sup>. In angioplasty

technique, advanced catheterization skills are needed to be developed for safe end results<sup>17</sup>.

Aging factor is associated with the Stenosis. It was observed that endarterectomy is effective in elderly patients whereas stenting is acceptable in young. The odds of stroke, cardiac disease/MI and death were higher in patients with age greater than seventy years; as compared to the patients with less than or equal to seventy years 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<sup>4,18</sup>. Moreover, it is also observed that cerebral / cranial injuries are frequent in carotid endarterectomy groups<sup>14</sup>.

With the increase of population, the patient to hospital load is also increasing day by day. Therefore, the hospitals stay / average length of stay in hospital has become a debatable factor. The angioplasty treatment is minimal invasive. Due to this procedure, the average length of stay for patient treated with carotid angioplasty is shorter than patients undergoes surgery procedure<sup>12</sup>.

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 group<sup>7</sup>.

Apart from comparison, the combination of both treatments has shown better results than the solo treatment. In addition to this, the combination of these treatments shows less postop complications<sup>19</sup>.

## CONCLUSION

Both Carotid endovascular treatments are safe and effective to some extent. In young patients, angioplasty is effective while in old patient's endarterectomy is effective. The combination of both techniques is costly but 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.

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