

# Comparison of Results Classical and Eversion Carotid Endarterectomy

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## ABSTRACT

**Introduction:** Atherosclerosis blood vessels, be it on extra-cranial or intra-cranial circulation, the most common cause of incidents such as cerebro-vascular insult (ICV). Carotid endarterectomy (CEA) is a preventive operation to reduce the risk of stroke and it can be performed by eversion carotid endarterectomy (E-CEA) or a classical carotid endarterectomy (C-CEA). The aim of this study was to investigate the influence of the used techniques in basic perioperative results and the incidence of postoperative complications. **Materials and Methods:** It was retrospective-prospective study that involved 173 patients, with carotid stenosis, who underwent CEA, in the period of time December 2013 till December 2016. Subjects were divided into two groups in respect of technique: 90 patients were treated with E-CEA and 83 patients were treated with C-CEA. **Results:** Between two groups revealed a significant difference in favor of the patients from group E-CEA in the length of the surgery ( $92.56 \pm 29.11$  min. vs.  $104.04 \pm 18.01$  min.,  $P = 0.000$ ), the time of clamping the carotid arteries ( $11.83 \pm 1.81$  min. vs.  $23.69 \pm 5:39$  min.,  $p = 0.000$ ), the amount of post-operative drainage ( $25.33 \pm 24.67$  ml. vs.  $36.14 \pm 14:32$  ml.,  $p = 0.001$ ), time spent in the intensive care unit ( $\pm 25.43$  vs.  $13:51$  hours  $34.54 \pm 35.81$  hours,  $p = 0.000$ ), and the length of stay ( $4.60 \pm 0.90$  days vs.  $5:42 \pm 1.80$  days,  $p = 0.001$ ). In the patients of the group E-CEA, fewer number of individual postoperative complications without statistical significance: ICV (2.2% vs. 4.8%,  $p = 0.351$ ), cardiac arrhythmia (2.2% vs. 4.8%,  $p = 0.351$ ), transitory ischaemic attack (TIA) and cognitive disorder (2.2% vs. 7.2%,  $p = 0.117$ ), mortality (1.1% vs. 1.2%,  $p = 0.954$ ); and the total number of postoperative complications was significantly less in the same patients (7.77% vs. 18.7%,  $p = 0.042$ ). **Conclusion:** The results of this study clearly indicate that operating techniques affects the specified monitored outcomes of vascular treatment of carotid arteries in favor of E-CEA technique. It would be ideally that the conclusions of this study contribute to broader use of E-CEA in treatment of carotid stenosis.

**Keywords:** Atherosclerosis, eversion carotid endarterectomy, carotid endarterectomy classic.

## 1. INTRODUCTION

Cerebro-vascular insult (ICV) as the result of atherosclerotic disease of the carotid arteries (stenosis, occlusion) is the third most common cause of death in industrialized countries, the most common neurological diagnosis that requires hospitalization (1), as well as the leading cause of long-term disability (2). In the elderly, the increased incidence of ICV is associated with carotid stenosis. It is known that the age over 50 years increases the risk of ICV four times, and age over 59 years increases the same for even 8 times (3, 4).

After the first carotid endarterectomy (CEA) done by De Bakey, the method is well established as a safe and effective way to lower the risk of ICV in patients with critical carotid artery stenosis. Today the CEA is surgical method with low mortality

and low intra-operative complication rate in most centers that deal with these issues. Also, it is well known the superiority of surgical treatment in patients with symptomatic (5) and asymptomatic carotid stenosis (6, 7).

There are two main techniques of CEA. More often used is conventional carotid endarterectomy (C-CEA) which is performed by longitudinal arteriotomy of the internal carotid artery (ICA), until eversion carotid endarterectomy (E-CEA) is used as an alternative and includes a transverse arteriotomy and anatomical reimplantation of ACI in the carotid bulb after distal eversion and plaque elimination.

The potential advantage of E-CEA is the fact that placing the patch at the same it is not necessary (8, 9, 10).

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## 2. AIM

The aim of the research was to compare the basic parameters of perioperative and early postoperative results in the treatment of carotid stenosis made with these two operating techniques.

## 3. PATIENTS AND METHODS

In this retrospective-prospective study were involved subjects with carotid stenosis undergoing E-CEA and C-CEA technique, in the period from December 2013 to December 2016. Regarding used surgical technique subjects were divided into two groups: E-CEA group with 90 patients operated with eversion technique and C-CEA group consisted of 83 patients treated by the conventional technique.

Between this two groups were analyzed and compared preoperative risk factors: hypertension (HTA), hyperlipidemia (HLP), smoking, diabetes mellitus (DM), coronary artery disease which is not surgically treated (CAD), and demographic representation in patients with significant carotid artery stenosis. Analyzed and compared perioperative results were: total duration of surgery (time from the first surgical incision to the last suture in minutes), the amount of postoperative bleeding (total amount of blood on the fiddle from leaving the operating room until the moment of removing the same, expressed in milliliters), time spent in the intensive care unit (ICU) (time of leaving the operating theater until moving to the department, in hours), length of hospitalization (time of surgery to go home, expressed in days). Postoperative complications that were analyzed: ICV, cardiac rhythm (atrial fibrillation), transient ischemic attack (TIA) and cognitive disorders, myocardial infarction (MI) and lethal outcomes.

Criteria for use in exclusion from the study were: patients with re-stenosis in the carotid arteries, stenosis carotid arteries with associated stenosis of branches of aortic arch segment, bilateral stenosis of carotid arteries > 70%, carotid arteries dissection, the simultaneous operation of CEA and coronary artery bypass or peripheral revascularization and heart valve surgery.

CEA was performed by eversion and classical technique, without the shunt. Surgical treatment was indicated in asymptomatic patients with stenosis of 70-99%, and in symptomatic patients with stenosis of > 60%. The degree of stenosis was determined by Doppler ultrasound and CT angiography / MR angiography. The main sources of data were computerized databases and standard histories of hospitalized patients (history, operating certificate, patient's medical/hospital list, letter of release from the hospital). In the assessment of the general condition of patients were involved anesthesiologists, vascular surgeons and neurologists independently from each other.

Technique E-CEA entailed transection at the level of the carotid bifurcation with the removal of atherosclerotic plaque distal displacement artery, followed by removal of plaque from the ACC and ACE anatomical reimplantation of ACI.

C-CEA technique performed with longitudinal arteriotomy of the ACI and ACC and removal of atherosclerotic plaque. Arteriotomy was closed primarily or using prosthetic patch. The same is used in cases of small diameter ACC and ACI (<5 mm).

## 4. RESULTS

Of the 173 respondents to the survey, the E-CEA group, there were 90, of whom 54 (60%) men and 36 (40%) were women, while the C-CEA group of 83 patients was 67 (80.7%) men and 16 (19.3%) women (p = 0.005). The average age of the E-CEA group was 64.94 years (SD 7.29, in the range of 49-84 years), median 65.0 (59.0–71.0) and 65.33 years (SD 7.2, range 51- 81 years), median 64.0 (59.0–72.0) to the C-CEA group (p = 0.562). Representation preoperative risk factors indicative of a number of the same in the E-CEA but not significant: Devices 44 (48.9%) versus 47 (56.6%), p = 0.467; HTA 50 (55.6%) versus 47 (56.6%), p = 0.887; HLP 31 (34.3%) versus 35 (42.2%), p = 0.296; DM 34 (37.8%) versus 36 (31.3%), p = 0.373; CAD and 26 (28.9%) versus 16 (19.3%); p = 0.141 (Table 1).

	E-CEA	C-CEA	p value
Patients	90	83	
Symptomatic patients/ asymptomatic patients	25/65	20/63	0.581
Male/Female	54 (60.0%)/36 (40.0%)	67 (80.7%)/16 (19.3%)	0.005
Mean age	64.54 ± 7.54	65.33 ± 7.02	0.562
CAD	26(28.9%)	16 (19.3%)	0.141
HTN	50 (55.6%)	47 (56.6%)	0.887
HLP	31(34.3%)	35 (42.2%)	0.296
DM	34 (37.8%)	36 (31.3%)	0.373
Smoking	44 (48.9%)	47 (56.6%)	0.467

Table 1. Demographics and Risk Factors

Analysis of basic peri-operative results points a statistically significant difference between the groups. The average length of the operation 92.56 minutes (SD 11.29, ranging from 60-120 min.) median 90.0 (90.0–100.0) in the E-CEA versus 104.04 min. (SD 1.18 min., In the range of 70-150 min.), median 105.0 (90.0–115.0) in C-CEA (p <0.0005), an average time of 11.83 min. was clamped ACI. (SD 1.81, in the range of 9-17 min.) median 12.0 minutes, 12.0 (10.0–13.0) vs. 23.69 min (SD 5:39, in the range of 15-45 min) median 22.0 (20.0–26.0) to the C-CEA (p <0.0005), the average amount of post-operative drainage 25.33 mil. (24.67 SD, range from -110 milliliters) median 20.0 (10.0–30.0) of the E-CEA as opposed to 36.14 milliliters (14:32 SD, range 5-70 milliliters) median 35.0 (30.0–45.0) in the C-CEA (p = 0.001), average time spent in the ICU 25.43 hours (SD 13:51, in the range of 20-111 hours) median 22.0 (21.0–23.0) versus 34.54 hours (35.81 SD, range from 20–336 hours) median 23.0 (22.0–28.0) to the C-CEA (p <0.0005), the average length of hospitalization after surgery 4.60 days (SD 0.90, range 3-9 days) median 5.0 (4.0–5.0) versus 5:42 days (SD 1.80, in the range of 3-14 days, median 5.0 (4.0–6.0); p = 0.001. (Table 2).

	E-CEA	C-CEA	p value
Operation time (min)	92.56 ± 11.29	104.04 ± 18.01	< 0.0005
Clamping time (min)	11.83 ± 1.81	23.69 ± 5.39	< 0.0005
Drainage (ml)	25.33 ± 24.67	36.14 ± 14.32	0.001
Staying in a ICU (hours)	25.43 ± 13.51	34.54 ± 35.81	< 0.0005
Hospitalization (days)	4.60 ± 0.90	5.42 ± 1.80	0.001

Table 2. Perioperative results in our study

Large perioperative stroke was more common in the C-CEA, 2 (2.2%) compared to 4 (4.8%),  $p = 0.351$ ; while lethal outcomes were represented as 1 (15.1%) versus 1 (1.2%),  $p = 0.954$ . Comparing other individual morbidity, between the groups, no statistically significant difference: atrial fibrillation 2 (2.2%) compared to 4 (4.8%),  $p = 0.351$ ; cognitive impairment and TIA 2 (2.2%) versus 6 (7.2%),  $p = 0.117$ ; myocardial infarction is not detected in either group. However, the analysis of intra-operative complications total, was significantly less in the same number of E-CEA group ( 7 versus 15,  $p = 0.042$  ) (Table 3).

	E-CEA	C-CEA	p value
Patients	90	83	
Major stroke	2 (2.2%)	4 (4.8%)	0.351
Death	1 (1.15%)	1 (1.2%)	0.954
Atrial fibrillation	2 (2.2%)	4 (4.8%)	0.351
TIA and Cognitive Impairment	2 (2.2%)	6 (7.2%)	0.117
MI	0 (0%)	0 (0%)	-
Total	7 (7.7%)	15 (18.07%)	0.042

Table 3. Perioperative complications ( 0–30 days).

## 5. DISCUSSION

After the first CEA which has made De Bakey (11), the same is established as a safe and effective method for reducing the ICV risk in patients with significant carotid stenosis. Today the CEA method with low mortality and incidence of perioperative complications, as symptomatic (5) and in asymptomatic carotid artery (6, 7). CEA is today in the world performs eversion and classical technique, with the still open question of superiority of any of them. Until recently the C-CEA was widely accepted, primarily due to somewhat weaker visualization of the distal part of the ICA when E-CEA (12). For a long time the E-CEA is considered an alternative technique in spite of proven good side of the same.

With the increase in the number of operations made E-CEA technique has increased the number of studies that analyze the results and the possible advantages and disadvantages of these two methods (13-15). Research Demirel and associates as advantages C-CEA informing about a greater 30 day risk of both stroke and death in patients treated with E-CEA technique (9% vs. 3%,  $p = 0.005$ ) (8), unlike the other speaking the significantly lower morbidity and mortality (1.35% vs. 4%,  $p < 0.005$ ) (16) and a smaller number of CVI (0.9% vs. 2.9%,  $p < 0.01$ ) and mortality 1.8%, compared to 0.54%,  $P < 0.05$  (17), in a patient operated E-CEA technique. In contrast to these, some studies have recorded a statis-

tically significant difference in the incidence of postoperative ICV and death in patients operated with these two operating techniques. Cao and associates compared the 678 patients who were treated with E-CEA 675 patients undergoing CEA-C, and reported that the incidence of perioperative mortality and ICV equal in both groups 1.3%,  $p = 0.8$  (18). On similar allegations we come with a lot of other authors (13, 19, 20).

However, studies Antonopoulos and associates indicates a lower risk of postoperative complications in E-CEA (21) on which also indicates the conclusions of this study: significantly fewer total complications in E-CEA techniques (7.77% vs. 18.7%,  $p = 0.042$ ). The conclusions of this are investigations point to the numerous advantages of E-CEA starting from the shorter length of surgery (92.56 ± 11.29 versus 104.04 ± 01.18 min.,  $P < 0.001$ ). Such manual found by other authors (19) in contrast to the Lee study, and associate that does not come to the same conclusion (143.9 ± 36.2 vs. 139.9 ± 30.8,  $p = 0.521$ ) (22).

Another advantage of the E-CEA, was obtained in this study, was shorter clamping ICA (11.83 ± 1.81 versus 23.69 ± 5:39 min.,  $P < 0.001$ ). Similar findings of the authors, and the other (25.5 ± 7.4 vs. 28.3 ± 10.1 4 min.,  $P = 0.0001$ ), (31.7 ± 15.9 vs. 34.5 ± 14.4 min.,  $P = 0.02$ ) (23,18) and in some studies, we find the shorter clamping the E-CEA, but this difference was not statistically significant (9:54 ± 2.6 vs. 12.62 ± 2.7 min.,  $p = 0.236$ ) (20). Other advantages of the E-CEA obtained in this study are less postoperative drainage quantity (25.33 ± 24.67 versus 36.14 ± 14:32 ml.  $P = 0.001$ ); spent shorter time in ICU (25.43 ± 34.54 versus 13:51 hours ± 37.81,  $p < 0.001$ ) and shorter overall hospital stay (4.60 ± 0.90 versus 1.80 ± 5:42 days,  $p = 0.001$ ).

## 6. CONCLUSION

Despite the well-known fact that the E-CEA is established method with very good results of treatment, it is still the world's controversy about the choice of operative technique and eventual advantages and disadvantages. The results of this study clearly indicate that operating techniques affects the specified monitored outcomes of vascular treatment of carotid arteries in favor of E-CEA technique. It would be ideally that the conclusions of this study contribute to broader use of E-CEA in treatment of carotid stenosis.

• Conflict of interest: none declared.

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