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Comparison of conventional surgical method and eversion technique in carotid endarterectomy operations

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Abstract

Background/Aim: Carotid endarterectomy is a highly effective and safe operation for preventing the risk of stroke in patients with symptomatic internal carotid artery stenosis. Several surgical techniques were described and available: Conventional carotid endarterectomy (CCEA) and eversion carotid endarterectomy (ECEA) are the two most common. Superiority of these two techniques to one another has not yet been clearly demonstrated. We aim to demonstrate the surgical and clinical experience of our institution regarding these two approaches.

Methods: In this retrospective cohort study, forty-three consecutive patients operated for symptomatic carotid stenosis were divided into two groups according to the preferred surgical method (CCEA and ECEA), and compared in terms of postoperative hospital stay, use of shunts and antibiotics, early (30-day) complications, long-term restenosis, and mortality rates.

Results: Demographic data and preoperative stenosis rates were similar between the two groups ($P>0.05$). In the CCEA group, subjects had a significantly longer clamping time (19.3 (4.1) vs 15.4 (3.4) min., $P=0.002$) and significant differences were found between operative time (35.1 (3.2) vs 28.7 (4.3) min) and need for shunting (25.7% vs 2.1%, $P<0.001$). CCEA patients had a higher percentage of antibiotic use (49.8% vs. 31.1%, $P=0.04$). Hematoma rates, complications during follow up, including stroke, heart attack, and mortality rate were similar between the groups, along with re-stenosis ($P=0.754$) and survival rates ($P=0.241$), according to Kaplan-Meier analysis.

Conclusions: Our results showed that ECEA was a convenient surgical technique and more advantageous compared to CCEA with respect to early and long term follow up results. ECEA can be performed within a significantly shorter operative time and may decrease the necessity for shunting, although it may require specific experience.

Keywords: Carotid stenosis, Eversion carotid endarterectomy, Conventional carotid endarterectomy

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Introduction

According to the World Health Organization, cerebrovascular diseases are the second most common cause of death worldwide following ischemic heart diseases [1]. Up to 8-10% of cerebrovascular events occur in the internal carotid artery [2]. Detection and treatment of the disease are very important in terms of health expenditures as well as preventing possible labor and function loss. The European Society for Vascular Surgery guidelines for management of extracranial carotid disease recommend carotid endarterectomy (CEA) for all symptomatic patients with a carotid stenosis of 70-99% [3]. CEA has been widely performed all over the world with increasing popularity and effectiveness since the 1980s. Perioperative stroke rate was 6.2% in CEA operations, which is shown to be quite safe compared to medical treatment or carotid stenting procedures [4].

Two methods are widely used for endarterectomy. The eversion carotid endarterectomy technique was first described by DeBakey [5]. In this technique, the internal carotid artery (ICA) is transected and separated from the common carotid artery at the level of its origin. The plaque inside the internal carotid artery is everted and removed and anastomosis is performed again with CCA. The plaque causing stenosis is reached with a longitudinal incision extending towards the ICA through the CCA in conventional carotid endarterectomy (CCEA). The arteriotomy incision on the carotid artery is closed by patching or primary suturing after removal of the plaque. This study aims to compare the early and mid-term results of these two methods.

Materials and methods

In this retrospective cohort study, the data of forty-three consecutive patients who were operated between 2013 and 2014 were reviewed. The patients were divided into two groups according to the operation technique used (ECEA and CCEA). Adana Numune Training and Research Hospital Non-Interventional Clinical Research Ethics Committee (02.12.2013 ANEAH.EK/91) approved this study. Patients who were operated on for the second time due to restenosis or underwent an additional surgical procedure in the same session due to other concomitant pathologies were excluded from the study. All subjects were evaluated by Doppler USG and computed tomography angiography or conventional angiography before the procedure. A team of at least one neurovascular specialist and at least one cardiovascular surgeon assessed all patients before surgical intervention. The eligibility of the patients for the surgical procedure was decided by the same team together with the imaging results. Optimal medical treatment was arranged for all patients before the procedure. All demographic data and clinical information were recorded. The data obtained during the operation, the use of a shunt, length of hospital stay, the incidence of perioperative cerebrovascular events, complications such as bleeding or hematoma requiring re-intervention in the early period (first 30 days), and significant (>50%) restenosis rates in long-term (1 year) follow-ups were noted.

All operations were performed under general anesthesia. Heparin was administered to the patients at 5000-6000 units/kg during the operation. Patients were followed up with routine monitoring and intermittent neurological examination for at least 24 hours in the vascular surgery intensive care unit after the operation. Doppler USG examination was performed to evaluate restenosis at the 12th and 18th months.

Statistical analysis

All data, retrospectively obtained from the clinical documents and hospital registry, were analyzed using Statistical Package for Social Sciences (SPSS for Windows, v.20.0; Chicago, IL, USA). Imaging and laboratory results, as well as operation notes were reviewed. Student-t test was used to evaluate statistical significance. A *P*-value <0.05 was considered significant.

Results

Demographic data and preoperative stenosis rates were similar between the groups. In the CCEA group, clamping (19.3 (4.1) vs 15.4 (3.4) min., *P=0.002*) and operative times were significantly longer (35.1 (3.2) vs 28.7 (4.3) min, *P=0.001*), and patients had a higher rate of antibiotic use (49.8% vs. 31.1%, *P*=0.04) (Table 1).

Table 1: Demographic and clinical data of patients

	CCEA (n=24)	ECEA (n=19)	*P*-value
Mean age (SD)	66.1(6.0)	66.8 (5.3)	0.685
Gender (male)	19 (79.2 %)	14 (73.2%)	0.817
Hypertension	8 (33.3 %)	7 (36.8 %)	0.152
Diabetes Mellitus	15 (62.5 %)	11 (57.9 %)	0.083
Hyperlipidemia	17 (70.8 %)	10 (52.6 %)	0.241
Current Smoker	16 (66.7 %)	11 (57.9 %)	0.068
Peripheral Vascular Disease	14 (58.3 %)	10 (52.6 %)	0.704
Ischemic Heart Disease	8 (33.3 %)	8 (42.1 %)	0.230
Symptomatic ICA disease	19 (79.2 %)	15 (78.9 %)	0.078
Previous cerebral infarct	19 (79.2 %)	16 (84%)	0.105
Preoperative medications			
Acetylsalicylic Acid	20 (83%)	15(78.9%)	0.681
Beta blocker	15 (62.5%)	11(57.8%)	0.083
ACE inhibitors	12 (50%)	11(57.8%)	0.360
Anticoagulant	2(8.3%)	0	0.241

The complication rates observed in the early postoperative period (within the first 30 days) did not differ between the two groups (Table 2).

Table 2: Intraoperative and early period (30 days) outcomes

	CCEA	ECEA	*P*-value
Operative Time (min), mean (SD)	92.7 (12.3)	74.9 (9.2)	0.001
Clamping Time (min), mean (SD)	19.3 (4.1)	15.4 (3.4)	0.002
Length of Stay in Hospital mean (SD)	2.54 (1.1)	2.37 (0.9)	0.734
Dysrhythmia, n (%)	0	1	0.387
Local cranial nerve injury	2 (8.3%)	1 (5.3%)	0.871
Stroke	0	0	-
Myocardial Infarction	1(2.3 %)	1(5,3%)	0.624
Death	0	0	-
Bleeding	2 (8.3%)	1 (5.3%)	0.871
Wound Infection (surface)	1(2.3 %)	0	0.582

Cranial nerve injuries (hypoglossal nerve, laryngeal nerve, recurrent laryngeal nerve, and glossopharyngeal nerve) at the surgical site were observed at a similar rate in both groups. Local nerve damage symptoms resolved in all patients in the following months. Superficial wound infection and hematoma rates were similar between the two groups. Neither deep wound infection, nor major stroke was observed in any patient in the early postoperative period. Protamine was not administered to reverse anticoagulation in any of the patients. Early complications are summarized in Table 2. Complications during the follow-up period, including stroke, heart attack, mortality rate, and according to Kaplan-Meier analysis, restenosis (*P*=0.754) and survival rates (*P*=0.241) were not significantly different between the groups (Figures 1, 2).

Figure 1: Kaplan-Meier analysis of no restenosis rates (The log-rank *P*=0.754)

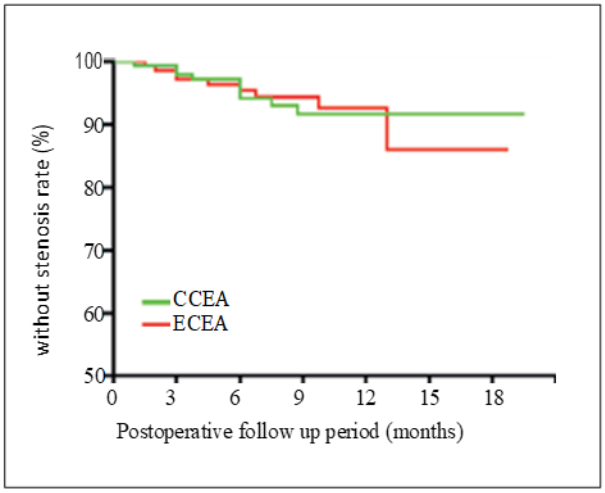
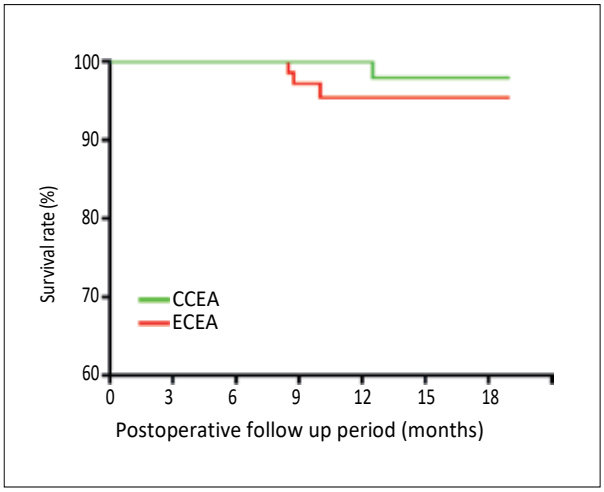


Figure 2: Kaplan-Meier analysis of survival rates (The log-rank test *P*=0.241)



Discussion

The eversion technique has become an alternative operative method with at least as much popularity as the conventional method. No superiority was demonstrated between the two methods in the early and late periods, similar to our study [6].

Surgically, endarterectomy is known to be superior to medical treatment than endovascular stenting [7]. The superiority of surgery can only be achieved by lower perioperative major complications and long-term restenosis rates. Therefore, it is very important that carotid surgery is performed by experienced surgeons in centers with sufficient experience of the procedure, as emphasized in the guidelines. A healthy evaluation, especially in terms of lesion localization, and implementing the most suitable method to the patient will yield optimum success in surgical results, even though both methods can be used in each patient in the centers that meet these conditions. Patients were operated on after the method was determined preoperatively without randomization in our study. ECEA is preferred more in lesions limited to ICA or those with a small association with the CCA, whereas CCEA is preferred in our own clinic, especially in lesions largely associated with CCA. We think that this selection played a role in the lower restenosis and stroke rates among our patients compared to the literature. There was no difference between the two groups in terms of efficacy and reliability in our study. Similarly, no difference was found between the two methods in terms of safety and efficacy in many randomized studies and meta-analyses [7-9]. Cross-clamp times were significantly shorter in ECEA patients, although this did not result in clinical advantage perioperatively. However, it may provide the opportunity to perform surgery within a safer time in patients with contralateral carotid lesions or intracranial vascular damage.

The incidence of infection has been reported around 1% in CCEA cases in which prosthetic patches were used [10]. Gram-positive staphylococci and streptococci have been identified as the most important responsible pathogens leading to bacterial infection [11]. It is important to consider this in routine antibiotic prophylaxis to eliminate the risk of infection. Superficial infection was observed in one patient in the CCEA group in our study; therefore, treatment did not require surgical debridement and revision. Especially infections of prosthetic patches may lead to severe conditions that cannot be compensated if the infection is not carefully managed.

Different results have been presented regarding shunt use. The idea of maintaining brain perfusion during the procedure seems very attractive. However, the use of shunts also has its own complications. It may be necessary to enlarge the arteriotomy to place the shunt, which may extend the cross-clamp time during placement. In addition, improperly placed shunts may cause embolisms. M. Jamil et al. showed that routine shunt use did not affect perioperative results [12]. On the other hand, there are studies indicating that selective and routine shunt use reduce the incidence of stroke [13, 14].

Arteriotomy incision is closed with a patch in CCEA operations in our practice. ECEA method was shown to be associated with relative risk reduction of 28% and 25% in 30-day and one-year stroke/death rates, respectively (30-day stroke/death: OR 0.72, 95% CI 0.54-0.95; stroke/death at 1 year: HR 0.75, 95% CI 0.58-0.97) compared to ECEA and patchless CCEA method [8,15]. Primary closure of the arteriotomy incision forms a more favorable ground for restenosis during vascular remodeling even though stenosis is reduced with the removed plaque when a patch is not used. This leads to higher complication and mortality rates within 30 days and one year.

Larger patient groups are needed to evaluate some data more healthily since our study was conducted among a limited patient group. The lack of evaluation of plaque morphologies constitutes another weakness of the study.

Conclusions

The results we reached in this study with a limited group of patients showed that both ECEA and CCEA operations were safe methods with very low complication rates. No significant clinical difference was observed in 12-month and 18-month long-term follow-ups in terms of safety and durability.

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