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Scientific Research

Timing of Carotid Endarterectomy: Perioperative Outcome According to Index Event to Operation Room Time

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Abstract

Aim: Carotid endarterectomy (CEA) is the choice of treatment for prevention of cerebrovascular events in vulnerable patients. In this single-center multi surgeon study, we aimed to evaluate outcomes of neurologically stable patients who underwent CEA after symptoms of cerebrovascular event according to time between the event and operation. Methods: In our clinic during 2008-2012, we applied 67 CEA to 65 patients. Ten of these 65 patients excluded from trial due to combined CABG operation. 18 patients were asymptomatic prior to operation and excluded. Thirty-nine of these patients were symptomatic and enrolled to study. Data were collected retrospectively. All enrolled patients were divided into two groups, according to the time between event and operation. Group I: Early Group (≤14 days). Group II: Late Group (>14 days). Results: In our clinic during 2008-2012, we applied 39 CEA procedures to consecutive 37 patients with symptomatic carotid artery stenosis. None of preoperative variables were associated with postoperative mortality ($p > 0.05$). We observed postoperative bleeding in one patient who was in Late Group (II). Postoperative bleeding was only associated with hyperlipidemia ($p = 0.003$). Postoperative stroke was observed in moderate cardiac risk patients in Early Group (I) ($p = 0.003$). But none of the postoperative complications were associated with study groups. We observed that, closure technique (primary closure) was associated with postoperative stroke ($p = 0.030$). We have achieved shorter waiting time during study time phrase but it couldn't reached statistical significance ($p = 0.196$). Conclusion: Although symptomatic patients have a higher risk of perioperative complications compared with asymptomatic patients, early CEA after symptom onset does not influence the results. This raises the question of the optimal timing of Carotid Artery intervention in sympto-

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matic carotid artery stenosis. To answer this question, more data are needed preferably from large randomized trials.

Keywords

Cerebrovascular Event, Carotid Artery Stenosis, Endarterectomy

1. Introduction

Carotid endarterectomy (CEA) is the choice of treatment for prevention of cerebrovascular events in vulnerable patients. European guidelines recommend revascularization within 2 weeks of index event (first symptom described by the patient) in patient with symptomatic carotid artery stenosis [1]-[5]. In several vascular centers including our clinic, shorter waiting times have been achieved over the last few years, but the majority of patients are still not treated within the recommended 2 weeks from symptoms [6]-[8].

Up to date, guidelines suggest early revascularization [4] but previously reported papers advocate late revascularization due to risk of non-hemorrhagic infarct transition into a hemorrhagic one and consequent extension of the infarcted area [9]. Rantner *et al.* demonstrated no difference in major complication rates among 29 CEAs performed before and 62 CEAs performed after 28 days from symptoms. Faggioli *et al.* reported no statistical difference of perioperative stroke rate according to operation time.

In this present single-center multi surgeon study, we aimed to evaluate outcomes of neurologically stable patients who underwent CEA after symptoms of cerebrovascular event according to time between event and operation.

2. Patients and Method

In our clinic during 2008-2012, we applied 67 CEAs to 65 patients. 10 of these 65 patients were excluded from trial due to combined Coronary Artery Bypass Grafting (CABG) operation. 18 patients were asymptomatic prior to operation and excluded. Thirty-seven of these patients (two patients had bilateral carotid endarterectomy) were symptomatic and enrolled to study. Data were collected retrospectively. Patients had either deep or superficial cervical plexus block anesthesia which was decided by anesthesiology, none needed to switch general anesthesia. Bupivacaine and lidocaine were used as anesthetic agents. Shunt was used in the absence of sufficientback flow to the internal carotid artery, or severe stenosis in contra lateral carotid artery or in patients with neurological deficits observed after clamping during the operation. Carotid arteriotomy was closed either primary or by using a patch. One of saphenousvein, Dacron, fabric or carotid patch was used. Postoperative all patients had standard medication dictated by guidelines such as antithrombotic, antiplatelet, statin, antihypertensive—if needed—, and antibiotic.

All enrolled patients were divided into two groups, according to the time between event and operation.

Group I: Early Group (≤14 days).

Group II: Late Group (>14 days).

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) 15.0 software (SPSS Inc. Chicago, IL, USA). Categorical data were expressed as percentages and continuous variables as mean with standard deviation. Possible significant differences were analyzed between the groups by means of the chi-squared test and Fischer's exact test. A p value < 0.05 was defined as statistically significant, thus adjusting for the fact that multiple analyses were performed.

3. Results

In our clinic during 2008-2012, we applied 39 CEAs to consecutive 37 patients with symptomatic carotid artery stenosis. Mean age of patients was 67.79 ± 10.19 (range 41 - 85). 15 (26.31%) of patients were female. Late group patients had more severe lesion but the difference did not reached statistical significance. Baseline patient

characteristics had no significant differences among groups (**Table 1**). In both groups major symptom was dizziness but patients' symptoms were not statistically different among groups ($p > 0.05$) (**Table 2**). None of preoperative variables were associated with postoperative mortality ($p > 0.05$). We observed postoperative bleeding in one patient who was in Late Group (II). Postoperative bleeding was only associated with hyperlipidemia ($p = 0.003$). Postoperative stroke was observed in moderate cardiac risk patients both were in Early Group (I) ($p = 0.003$) but none of the postoperative complications were associated with study groups (**Table 3**). We observed that, closure technique (primary closure) was associated with postoperative stroke ($p = 0.030$). We have achieved shorter waiting time during study time phrase (particularly last year) but it couldn't reached statistical significance ($p = 0.196$) (**Figure 1**) (**Table 4**).

Table 1. Demographic variables of patients.

Demographic Characteristics	Group I (early) (n = 15)	Group II (late) (n = 24)	p
Mean Age, yr (SD)	68.27 ± 10.0	68.0 ± 10.70	
Male	9	19	0.196
Hypertension	8	12	0.55
Diabetes	5	5	0.384
COPD	4	4	0.686
Hyperlipidemia	2	2	0.681
PAD	0	3	0.274
Cardiac			
High risk	0	2	0.452
Moderate risk	3	3	
Low risk	12	19	n/a
Dialysis	0	0	
Arterial Closure			
Patch	13	18	
Primer	2	6	0.99
Carotid lesion			
Ipsilateral	74.27 ± 16.46	83.63 ± 14.01	0.066
Contralateral	26.67 ± 19.48	29.96 ± 12.17	0.642

COPD: chronic obstructive pulmonary disease, PAD: peripheral arterial disease, TIA: transient ischemic attack.

Table 2. Symptom to operation time.

		Group I (early) (n = 15)	Group II (late) (n = 24)	p
Symptom	Dizziness	6	11	
	Left-sided hemiparesis	1	2	
	Right-sided hemiparesis	0	5	
	TIA	2	0	
	Uneventful CVE	0	1	0.129
	Syncope	0	1	
	Amaurosis fugax	0	1	
	Numbness in the arm	2	0	
	Major stroke	4	3	

TIA: transient ischemic attack, CVA: cerebrovascular event.

Table 3. 30 day outcomes.

30-day outcomes	Group I (early) (n = 15)	Group II (late) (n = 24)	p
Mortality	1	0	0.2
Stroke	2	0	0.066
MI	0	0	n/a
Bleeding	0	1	0.423

MI: myocardial infarction.

Table 4. Operation years vs groups.

		Group I (early) (n = 15)	Group II (late) (n = 24)	p
Operation year	2008	0	4	
	2009	1	3	
	2010	5	8	0.196
	2011	2	5	
	2012	7	4	

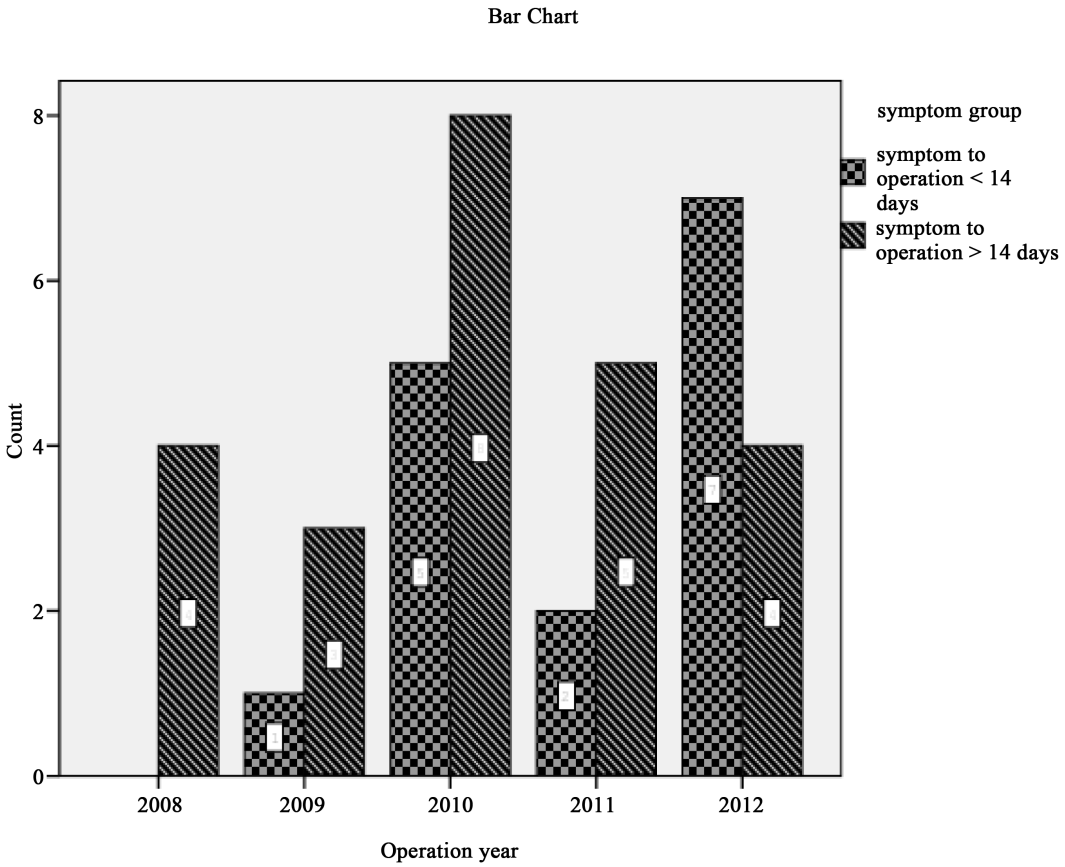

Figure 1. Operation years vs groups.

4. Discussion

The main purpose of urgent carotid endarterectomy is to improve blood flow to ischemic areas and eradicate the source of embolic events secondary to unstable atheromatous plaque in the internal carotid artery. Up to date, guidelines suggest early revascularization [4] but previously reported papers advocate late revascularization due

to risk of non-hemorrhagic infarct transition into a hemorrhagic one and consequent extension of the infarcted area [9]. Parallel to up to date data, our patients had short waiting time for operation but the difference did not reach statistical significance ($p > 0.05$). The early endarterectomy in symptomatic patients began with the improved results of pooled analysis from the ECST and NASCET trials in the 1990s [10]-[12]. Rantner *et al.* demonstrated no differences in major complication rates in 29 CEAs performed before or 62 CEAs performed after 28 days from symptoms [13]. More importantly, they observed secondary ischemic stroke in 11.8% of their delayed CEA cohort during the 4-week waiting period. Ballotta *et al.* showed in a prospective study of 45 patients randomized to early CEA and 41 randomized to delayed CEA that there was no difference in perioperative stroke rates, survival, or stroke in 3 years [14] Capoccia *et al.* reported that, 93.5% (58 of 62) of patients undergoing CEA within 2 weeks of symptom onset experienced National Institutes of Health Stroke [15] Scale (NIHSS) score improvement upon treatment. Finally, as in this study, Paty *et al.* reported no difference in the rates of perioperative stroke resulting in permanent neurologic deficit by time elapsed after symptom onset (Week 1:2/72, 2.8%; Week 2:2/59, 3.4%; Week 3:1/29, 3.4%; Week 4:2/78, 2.6%) [16]. We observed postoperative stroke in two (5.1%) patients in early revascularization group. The etiology was transition to hemorrhagic stroke. Annambhotla *et al.* reported a significantly higher rate (1.6%) of perioperative stroke in their late CEA group ($n = 243$) [17]. Faggioli *et al.* reported no statistical difference of perioperative stroke rate according to operation time [18]. Patients with primary closure of arteriotomy in CEA are prone to postoperative stroke. In this study, we detected that, primary closure is a risk factor for postoperative stroke ($p < 0.05$). Cochrane library reviews compared different patch materials. The differences were very small. Only reported differences were; PTFE patches were superior to collagen-impregnated Dacron grafts in terms of perioperative stroke and restenosis. We observed no statistical significance. Pseudoaneurysms were more common after a vein patch than with a synthetic patch [19]. Also in a study conducting 48,035 patients, Menyhei *et al.* reported standard endarterectomy without patch had a significantly higher stroke rate than the standard method with patch [20]. Although there are papers saying intracerebral hemorrhage may be main reason for cerebrovascular complications there widely held beliefs to claim microemboli. David G *et al.* reported intracerebral hemorrhage as cause of post CEA cerebrovascular event [21] Verhoeven suggests that, prevention of embolic events should contribute to a decrease in adverse cerebral events. He believes emboli occurring not only during dissection of the atherosclerotic plaque are associated with an increased risk of surgery and during closure of the vessel are also related with adverse outcome [22]-[24]. None of patients had perioperative myocardial infarction (MI). NASCET trial reported 0.5% post CEA MI and Bevilacqua and friends reported 1.1% postoperative MI [10] [25]. We had observed 30 day mortality in 1 (2.5%) patient which was in Early Group. Our result was parallel to literature [10] [11].

This study had some limitations. Because this study was retrospective and randomization between patch materials was not performed, it is conceivable that there are differences in patient characteristics among the groups and that a selection bias led to the use of patches in patients with more severe disease. However, we studied these characteristics and could not identify such a difference. Additionally, the study was limited by the number of patients with CEA. Finally, our long-term follow-up was limited to 30 days.

5. Conclusion

Although symptomatic patients have a higher risk of perioperative complications compared with asymptomatic patients, early CEA after symptom onset does not influence the results. This raises the question of the optimal timing of Carotid Artery intervention in symptomatic carotid artery stenosis. To answer this question, more data are needed, preferably from large randomized trials.

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Conflicts of Interest

None.

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