Comparison of Coronary Bypass Grafting Surgery with Carotid Endarterectomy and Coronary Bypass Grafting Surgery

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Abstract

Introduction: Treatment of combined coronary artery surgery (CABG) and severe carotid artery stenosis is still controversial. The decision of surgical priority can change according to the severity of the coronary artery disease or carotid artery disease at staged surgery. The aim of the study is to compare the outcomes of simultaneous surgery (CEA + CABG) and CABG alone at our department. **Materials and Methods:** We retrospectively reviewed the CABG and CEA + CABG patients which were performed between 2010 and 2015. If the patients had simultaneous another operation, they were excluded from the study. A total of 294 patients (252 CABG patients and 42 combined surgery patients), were retrospectively examined. **Results:** Two patients in CABG group and two patients in CABG + CEA group developed stroke. There was no statistically significant difference between the two groups in terms of early stroke rate (p > 0.05). One patient in CEA + CABG group and three patients in CABG group died. The average carotid clamp time was 19.93 ± 5.06 minutes. Aortic clamp times were 42.89 ± 6.38 minutes in CABG and 42.81 ± 5.70 minutes in CEA + CABG patients. Results of the two groups were similar. **Conclusion:** Combined CEA and CABG can be performed successfully and safely in patients.

Keywords

Coronary Artery Surgery, Carotid Endarterectomy, Combined Surgery

1. Introduction

Being between 5% and 14%, the incidence of combined coronary artery disease (CoAD) and severe carotid artery disease (CaAD) is high. Treatment of the combination of the two diseases is still controversial [1]. Stroke is still an impor-

tant complication of coronary artery bypass grafting (CABG). The benefit of carotid endarterectomy (CEA) over medical therapy in both symptomatic and asymptomatic patients has been established in randomized trials [2]. If the patients have left main coronary artery (LMCA) disease, proximal left anterior descending artery (LAD) disease or severe three-vessel CoAD, performing carotid endarterectomy (CEA) as the first line treatment has high risk [3]. Also, CoAD (LMCA and LAD lesions) presents high frequency (5% - 14%) with atherosclerosis of carotid arteries. Patients with LMCA and proximal LAD lesions should undergo carotid Doppler ultrasonography [1]. The patients with a concomitant CoAD and CaAD can be operated through staged approach or combined approach.

Surgeon can perform first carotid endarterectomy or CABG at staged approach. The decision of surgical priority can be changed according to the severity of the coronary artery disease or carotid artery disease. Some previous studies recommended staged operation based on that the simultaneous surgery has higher risk than staged surgery [4] [5] [6]. The aim of the study is to compare the outcomes of simultaneous surgery (CEA + CABG) and CABG alone at our department.

2. Materials and Methods

We retrospectively reviewed the CABG and CEA + CABG patients which were performed between 2010 and 2015. Patients historical health records were investigated for data. Preoperative risk factors, operative technique, perioperative morbidity, mortality, early and midterm results were evaluated. A total of 294 patients were included in the study. There were 252 patients in group 1 (CABG) and 42 patients in group 2 (CEA + CABG). The patients who received simultaneous other operation were excluded from study. CABG patients were evaluated with carotid Doppler ultrasonography. All surgeries were performed under general anesthesia. Firstly, CEA was performed in group 2. CEA was performed with classical approach using a patch. Before the carotid arteries were clamped 5000 IU heparin was administered intravenously. The dose of heparin was completed to 300 IU/kg after CEA, graft harvesting and sternotomy. Aorto-unicaval (two-staged) cannulation was performed in both groups. All CABG's were performed under cardiopulmonary bypass (CPB). Anastomoses were made with polypropylene sutures. While heparin was fully reversed in group 1. it was partially (80%) reversed in group 2 because of the surgery of the CEA. After the operation patients were transferred to intensive care unit (ICU). CEA patients were monitored least one day in the ICU. Also, CABG + CEA patients were monitored at least two days in the ICU. If the patients didn't have any complication and the patent's hemodynamic parameters were normal, they were transferred to the ward.

If the patients had any complication, they investigated by other departments. Stroke patients were evaluated by neurology department with computerized to-

mography (CT), magnetic resonance (MR) etc. Management of these patients was organized with neurologists. Early stroke and other complications were followed for 30 days.

PSPP version 1.2.0 software (Free Software Foundation Inc., Boston, MA, USA) was used for statistical analysis. The continuous variables were not normally distributed, so they were presented as mean with standard deviation. The categorical variables were presented as frequency and percentage rate. While continuous variables between two groups were compared with T-test, the categorical variables were compared with Chi-square test or Fischer's exact test with continuity correction. A p-value of < 0.05 was considered statistically significant. Sample sizes were determined with G'Power analyses program; alpha value was 0.05 and power value was 80% G*Power version 3.1.9.4 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). Significant p-value was set to < 0.05.

This study was approved by Eskisehir Osmangazi University Ethic Committee (8055871/G-47).

3. Results

The mean age of patients was 63.41 ± 5.64 ingroup 1 and 65.48 ± 4.608 ingroup 2. The rate of male gender was 58.3% in group 1 and 50% in group 2. Smoking rates were also similar between the groups. Diabetes mellitus (DM) rates were 18.3% in group 1 and 33.3% in group 2. The rate of DM was higher in group 2. (p < 0.05) There was no statistical difference between the two groups in terms of the rate of smoking, hypertension, hyperlipidemia, peripheral artery disease and medical histories. There was 9.5% bilateral carotid occlusion in group 2 (Table 1).

Carotid artery clamp-time was 19.93 ± 5.067 minutes in group 2. Aortic clamp times were 42.89 ± 6.384 minutes in group 1 and 42.81 ± 5.701 min in group 2. Mean operation-times were 203.31 ± 17.084 minutes in group 1 and 238.17 ± 16.056 minutes in group 2. There was a statistically significant difference in regards to operation-times which was due to the CEA surgery in group 2 (p < 0.05). Postoperative stroke was detected 2 (0.4%) patients in group 1 and 2 (4.8%) patients in group 2. There was no significant difference between the two groups in regard to early stroke rate (p > 0.05). The mean length of ICU-stay was 2.1 ± 0.42 days in group 1 and 2.1 ± 2.2 days in group 2. The mean length of hospital-stay was 6.96 ± 0.57 days in group 1 and 6.08 ± 0.67 days in group 2. The mean value of mediastinal bleeding was 497.56 ± 63.84 ml in group 1 and 648.81 ± 155.82 ml in group 2. Bleeding was statistically higher in group 2. There were 3 (1.2%) mortality in group 1 and 1 (2.4%) mortality in group 2. Operative and postoperative data were revealed in Table 2. Patients were followed 30 days for early term results and one year for midterm results.

Mediastinal bleeding and operation time were statistically higher in group 2. But there wasn't statistical difference about other perioperative and postoperative outcomes at both groups.

Table 1. Comparison of demographic and clinical data.

Variable	Group 1 (n: 252) n (%)	Group 2 (n: 42) n (%)	p-value
Age (years)	63.41 ± 5.640	65.48 ± 4.608	0.025 (a)
Gender (Male)	147 (58.3)	21 (50.0)	0.312 (b)
Smoke	101 (48.8)	25 (44.6)	0.299 (b)
Diabetes mellitus	46 (18.3)	14 (33.3)	0.025 (b)
Arterial Hypertension	67 (26.6)	16 (38.1)	0.125 (b)
Bilateral Carotid Stenosis		4 (9.5)	
PAD	17 (6.7)	4 (9.5)	0.746 (c)
Medical History	9.1 (23)	14.3 (6)	0.299 (b)
Hyperlipidemia	47 (18.7)	16 (38.1)	0.004 (b)
MI	85 (33.7)	15 (35.7)	0.189 (b)

PAD: Peripheral Arterial Disease, MI: Myocardial Infarction. [a]Mann Whitney U test, [b]Pearson Chi-Square, [c]Fischer exact test (continuity correction).

Table 2. Clinical outcomes.

	Group 1 (n: 252) n (%)	Group 2 (n: 42) n (%)	p-value
Carotid X clamp (min)	-	19.93 ± 5.06	
Aortic X clamp (min)	42.89 ± 6.38	42.81 ± 5.70	0.935 (a)
Operation time (min)	203.31 ± 17.08	238.17 ± 16.05	**<0.001 (a)**
Postopetaive CVE	2 (0.8)	2 (4.8)	0.182 (b)
Stroke sequel	1 (0.4)	1 (2.4)	0.185 (b)
ICU time (day)	2.1 ± 0.42	2.1 ± 2.2	0.780 (a)
Postoperative Stay (day)	6.96 ± 0.57	6.08 ± 0.67	0.285 (a)
Bleeding (ml)	497 ± 63.8	648 ± 155.8	**<0.001 (a)**
Mortality	3 (1.2)	1 (2.4)	1.000 (b)

X Clamp: Cross clamp, CVE: Cerebrovascular Event, ICU: Intensive care unit. [a]Mann Whitney U test, [b]Pearson Chi-Square, [c]Fischer exact test (continuity correction).

4. Discussion

The role of carotid artery stenosis in cerebrovascular events is at least 20%. Carotid endarterectomy is the golden-standard treatment modality for severe carotid artery stenosis [7]. Stroke is an important complication of CABG [2]. Many articles pointed out the high risk of combined CEA and CABG approach [2] [3] [4]. Performing CABG primarily as the initial step in combined surgery could create high risk for stroke. On the other hand, performing CEA initially without CABG could have a high risk myocardial infarction [2] [5]. In which order these operations should be performed is still controversial. Many surgeons prefer CABG at first step, because of the myocardial infarction risk. If first step was CABG, there was stroke risk. CABG patients should be evaluated with carotid

Doppler ultrasonography before operation [8].

Borger *et al.* evaluated a metanalysis of 16 publications. There were 844 combined and 920 staged operations. They show that the stroke and death rates in combined group were higher in two studies in these metanalyses. They stated that they needed more randomized and prospective studies for certain risks and results. They calculated 1500 patients needed for this prospective study [1]. In this study, there were 2 (0.4%) strokes in group 1 and 2 (4.8%) strokes in group 2. It seems that stroke ratio is higher in group 2 but no statistical difference was detected (p > 0.05). There was no severe carotid stenosis in CABG group. This is the difference of our study than the others. We think that this will reveal the better results. Group 1 is a valuable control group. Borger *et al.* revealed some publications showing that there was no statistical difference between combined and staged surgery [1].

CPB and carotid cross-clamp times were important determinants of perioperative stroke in CABG patients [1] [9] [10]. Mean carotid cross clamp time was 19.93 ± 5.06 minutes in group 2 in the current study. Aortic cross clamp time was 42.89 ± 6.38 minutes in group 1 and 42.81 ± 5.70 minutes in group 2. Stroke rates could be similar between the two groups because of the similar aortic clamp times. Diagostino *et al.* showed that if aortic cross-clamp and CPB durations are high, the risk of stroke increases [10]. This result supports our study. However, in our study, the aortic cross-clamp time of one stroke patient was 33 minutes in group 1. Atrial fibrillation appeared in this patient at third postoperative day and right hemiparesis was revealed. There was no sequel after one month. One of the stroke patients in group 2 had aphasia in the ICU follow-up duration, but he fully recovered after one day. This patient's aortic cross-clamp time was 45 minutes, and carotid cross-clamp times were 26 minutes. Also, his total operation time was 248 minutes. There was one patient with right hemiparesis in group 1 and one patient with left hemiplegia in group 2 after six months. Total operation time was 203.31 ± 17.08 minutes in group 1 and 238.17 ± 16.05 minutes in group 2. Total operation time was statistically higher in group 2 (p < 0.05). There was no difference in stroke rate despite this statistical difference of operation times.

Total bleeding was higher in group 2 (p < 0.05) The bleeding amounts were 497 ± 63.8 ml in group 1 and 648 ± 155.8 ml in group 2. We think that this difference stemmed from the anticoagulation strategy. Heparin was partially reversed with protamine in CEA + CABG group, and 300 IU/hour heparin infusion was started in the ICU after two hours of the operation. One patient underwent reoperation because of mediastinal bleeding in group 2. Newhall *et al.*'s metanalyses shown that partially reversed heparin causes more bleeding. On the other hand, full reversed heparin causes more reoperations, stroke and death [11]. Partial reversed heparin strategy was chosen to avoid serious complications in our department.

A three approach comparison study of Shishehbor *et al.* showed that the risk of myocardial infarction in staged operations was higher. Although the stroke

rate was numerically higher than the others, they could not detect any statistical difference [12]. Gopaldas *et al.* compared two groups (Combined and staged surgery), and they stated that there was no difference between two groups in terms of mortality, stroke and inter-stage risks. However, the hospital charge of staged group was higher than combined group [13]. Yapici *et al.*'s study showed there was one major stroke in combined surgery and 3 deaths. They think it was an acceptable complication rate of combined surgery [14]. Kaul *et al.* didn't find statistical difference combined and staged group about mortality. They were using combined surgery routinely [8]. Also, our study showed similar stroke and death rates between the two groups. The duration of hospital stay and ICU stay between the groups were similar. This can indicate that combined surgery (CABG + CEA) is a safe method. CEA timing is important. Symptomatic and asymptomatic patients evaluated many times at big series and metanalyses [9] [13]. If there was CoAD with CaAD, CEA timing is more important. This study could guide to the timing of CEA at CaAD patients.

5. Conclusion

Combined CEA and CABG can be performed successfully and safely in patients. Also, combined surgery has some advantages like shorter hospital stay, acceptable early mortality and morbidity rates.

6. Limitations

This study has well-known retrospective design limitations. Also staged surgery was not investigated. But aim of the study was investigating safety of combined surgery. One of other limitation is number of combined surgery patients low. Power analyses were shown adequate patients at groups. Prospective and larger series could show better results.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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