

A New Approach to Myocardial Revascularization in Patients with Severe Carotid Lesions: Simultaneous Cardiopulmonary Bypass and Local Carotid Endarterectomy

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Abstract

Aim: In the present study, we aimed to present the retrospective outcomes of the patients who underwent carotid endarterectomy under local anesthesia followed by cardiopulmonary bypass under general anesthesia during the same session.

Material and methods: 52 patients (36 male, 16 female patients; mean age was 69.0 ± 8.5 years; range 42 to 75 years) with carotid lesions underwent carotid endarterectomy under local anesthesia and simultaneous cardiopulmonary bypass between 1st March 2015 and 1st March 2016 in our center. This study involved patients with myocardial revascularization and 80% or more carotid stenosis (with or without contralateral disease). Preoperative, preoperative and postoperative characteristics of the patients were retrospectively analyzed.

Results: Operative mortality rate was 1.9% with one patient. Early postoperative revision was performed in 3 patients (5.7%) bleeding. Postoperative atrial fibrillation developed in 6 patients (11.5%). There was no cerebrovascular accident postoperatively.

Conclusion: The incidence of coronary and carotid artery disease coexistence is not too low. The combined approach increases the stroke and mortality rate by using general anesthesia in the procedure, although the odds of complications appearing to reduce the duration of hospitalization with the performance of a single seansa procedure. In this study, we reported that local carotid artery intervention and simultaneous coronary artery bypass surgery reduced the stroke risk and mortality rates.

Keywords: Combined treatment; Local anesthesia; Carotid endarterectomy; Cardiopulmonary bypass

Introduction

Despite the advances in the cardiopulmonary bypass, stroke that may develop during or after the intervention continues to be an important cause of morbidity and mortality. It was reported that the risk of stroke during coronary artery bypass increases to 8% at the ages of 80s from 0.5% in 50s. There are close relationships between coronary artery disease and carotid stenosis, and between critical carotid stenosis and stroke [1].

Debates still continue on the timing of cardiopulmonary bypass and planned carotid endarterectomy in patients with coronary artery disease and severe carotid stenosis. The first simultaneous intervention was described by Bernard et al. [2] and Mackey et al. [3] suggested three different ways for coronary artery disease surgery in terms of sequence and timing of the surgery. Those are simultaneous, staged and reverse-staged (coronary surgery followed by carotid endarterectomy) approaches. However currently debates still continue and there is no consensus on these approaches yet. There are concerns that the cerebral blood flow will decrease in the simultaneous approach. Many surgeons are reluctant to perform carotid endarterectomy first, worrying that myocardial infarction may occur during the operation. On the other hand, performing cardiopulmonary bypass first has been reported to increase the stroke rates [4].

Since operations requiring cardiopulmonary bypass are performed under general anesthesia, carotid endarterectomy surgery with simultaneous cardiopulmonary bypass are also performed under general anesthesia. Some publications reported that interventions under general anesthesia increase the rates of stroke and death [5].

In this retrospective study, we aimed to present the outcomes of the

patients who underwent carotid endarterectomy under local anesthesia followed by cardiopulmonary bypass under general anesthesia during the same session.

Material and Methods

In this retrospectively study, patients who underwent carotid endarterectomy under local anesthesia and simultaneous cardiopulmonary bypass for coronary artery disease in the same season in our institute between March 2015 and March 2016 in our center were included.

There were 52 patients, 36 male (69%), 16 female (31%); and mean age was 69.0 ± 8.5 years (42 to 75 years). Exclusion criteria were as follows: emergency, off-pump surgery, deep hypothermic cardiopulmonary bypass, myocardial infarction, concomitant surgery (valve replacement, or aortic root replacement). 23 had vertigo (44.2%), 19 had syncope (36.5%) and 16 had transient ischemic attack (31%) (TIA). One patient had bilateral carotid stenosis (1.9%). Preoperative characteristics of the patients are shown in Table 1.

All patients underwent preoperative ultrasonic diagnostics, digital

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subtraction angiography, neurological examination and cardiac catheterization. The principal indication was the need for myocardial revascularization, and symptomatic or asymptomatic carotid stenosis of 70% diameter reduction or more (with or without contralateral disease) (Table 2).

The clinical worksheet list was used to collect the patients' demographic information (age, gender), past history with regard to myocardial infarction, vertigo, syncope and transient ischemic attack (TIA) in Table 3.

Surgical Technique

All surgical procedures were performed by the same surgical team. On supine position, and under local anesthesia with Marcaine 5% plus Priloc 2%, a vertical incision was made along the edge of the

sternocleidomastoid muscle for carotid endarterectomy. The carotid artery was explored. The common carotid artery (CCA), external carotid artery (ECA) and internal carotid artery (ICA) were identified, followed by administration of intravenous heparin at a dose of 50 IU/kg. Clamps were applied to the common carotid artery, external carotid artery and internal carotid artery, and a longitudinal incision was made from the CCA to the ICA. Carotid endarterectomy was performed using an intraluminal shunt (Flash Med S.A.*) in all patients. The carotid artery clamping took 11 ± 3.7 minutes on average. The arteriotomy was closed primarily in 40 patients with an internal carotid diameter of 5 mm or above, and great saphenous venous or Dacron patch was used in 12 others.

After this procedure, the subcutaneous and cutaneous tissues were not closed until the CABG procedure was completed and after weaning from the CPB. Tamponade was performed. Then a median incision and sternotomy was performed under general anesthesia. Grafts (great saphenous vein, left internal mammary artery) were harvested for use in anastomosis. A standard cannulation was performed. Patients were cooled to 32 degrees and cardiopulmonary bypass (CPB) started. Cardiac arrest with antegrade blood cardioplegia was performed with aortic root cannula under aortic cross clamp. Distal anastomoses were performed. The mean number of grafts per patient was 3. In all patients, proximal anastomoses were performed with side clamp during the CPB. Following removal of the side clamp and weaning from the CPB, firstly the chest and then the carotid area were closed. A penrose drainage tubing (NULIFE*) to prevent pressure due to a possible haematoma on the carotid artery in all patients. The intraoperative data of the patients are shown in Table 3. The patients were transferred to the intensive care unit after the operation. During the postoperative period, Enoxaparin 2×0.6 cc, Clopidogrel 1×75 mg and Acetylsalicylic acid (ASA) 1×100 mg was administered. Enoxaparin was given during the first 3 postoperative days. Following discharge, Clopidogrel and ASA were used as antiaggregant agents. Patients were discharged on the average postoperative 5th day.

Demographic Data	Number	Percent
The average age (yrs)	69 ± 8.5	
Woman/Man	16/36	31/69
Family history	5	9.60%
Hypertension	30	57.70%
KOAH	35	67.30%
Smoking	35	67.30%
Hyperlipidemia	33	63.50%
Diabetes Mellitus	13	25%
Peripheral arterial disease	35	67.30%
Coronary artery occlusion	28	
Main coronary artery	0	
Single-vessel lesion	3	
Two vascular lesion	4	
Three vascular lesion	13	
Four vascular lesion	8	
TIA	16	31%
Vertigo	23	44.20%
Syncope	19	36.50%
History of epilepsy	3	5.70%

Table 1: The demographic data of patients.

Distribution of patients	Number	Percent
Right internal carotid	32	61.50%
Left internal carotid	19	36.50%
Bilateral Carotid	1	1.90%

Table 2: The distribution of patients with carotid artery stenoses rates and challenges.

Intraoperative Data	Number
Cardiopulmonary bypass time (dk)	38.5 ± 15.2
Cross clamp time (dk)	18.6 ± 5.7
Carotid clamping time (dk)	11 ± 3.7

Table 3: Intraoperative data.

Postoperative data	Number	Percent
Mediastinal bleeding	3	5.70%
Arrhythmia	6	11.50%
Atrial fibrillation	6	11.50%
Stroke temporary/permanent	0	0
Inotropic requirement	8	15.30%
ICU length of stay (hour)	14.9 ± 7.4 hour	
The length of hospital stay (days)	5.2 ± 1.7 day	
Ekxitus	1	1.90%

Table 4: Postoperative data.

Statistics

All statistics were performed using SPSS 15.0 for Windows (SPSS, Inc., Chicago, IL, USA). Normally-distributed continuous variables were expressed as mean ± standard deviation (SD) and variables without a normal distribution were expressed as median and ranges. Categorical variables were expressed as frequencies and percentages.

Results

Postoperative 30-day observations were made. One (1.9%) of the patients died later due to low cardiac output on postoperative 5th day. Postoperative atrial fibrillation developed in 6 (11.5%) patients, and treated with intravenous amiodarone infusion. No major or minor cerebrovascular event was observed. In 8 (15.3%) patients, dopamine and adrenalin were administered in the intensive care unit due to low cardiac output. Three (5.7%) patients were revised due to postoperative bleeding. The mean length of stay in the intensive care unit was 14.9 ± 7.4 hours, duration of ventilation was 7 ± 1.5 and length of stay in the hospital was 5.2 ± 1.7 days. The post-operative complications and data are shown in Table 4.

Discussion

Decreased cerebral blood flow during cardiopulmonary bypass is one of the factors causing postoperative ischemia. In fact, non-pulsatile flow and unstable arterial pressure that may develop during cardiopulmonary bypass are triggering factors of neurological events [6].

Carotid stenosis is an important risk factor for stroke since it increases the risk of cerebrovascular events by 10% in patients who undergo cardiopulmonary bypass surgery [3,7]. It was reported that, carotid stenosis above 70% was detected in 10%, stenosis between 50% and 70% in 9% to 22%, and stenosis under 50% in 80% to 91% of all patients for whom cardiopulmonary bypass was planned [8]. Considering that carotid artery stenosis is related with stroke, we performed carotid doppler ultrasonography and included those with stenosis of 70% in our study.

Also, due to the association of coronary artery disease and carotid atherosclerotic stenosis, different centers try different approaches. The main aim is to reduce the incidence of postoperative stroke in all approaches (i.e. staged, combined or simultaneous hybrid revascularization) [9].

Debates still continue on how the best approach to the combined operation, which was firstly performed by Bernhard et al. [2], should be [10]. Many studies have been conducted on this which generally gave similar results in terms of cerebrovascular events, myocardial infarction and mortality. In their meta-analysis for simultaneous and staged surgical treatment, Sharma et al. [4] observed equivalent mortality and stroke profiles, and reported that some specific characteristics of patients and atherosclerotic disease morphology are more important.

Another study with a multi-center design demonstrated that the rate of stroke increased by 10% in patients who underwent cardiopulmonary bypass followed by carotid endarterectomy, and based on this information, found that this rate is significantly higher compared to the combined surgery [11]. Yildirim et al. [12] reported that carotid endarterectomy and cardiopulmonary surgery under cardiopulmonary bypass is a safe method with acceptable mortality and morbidity rates. In their retrospective study, Byrne et al. [5] reported low mortality and morbidity rates in 758 patients with hemodynamically significant but asymptomatic carotid stenosis who underwent combined surgery. We thought that the combined operation would protect the patient from complications such as stroke and mild and the patient underwent carotid endarterectomy and coronary bypass in the same session.

Gopaldas et al. [13] reported that they did not observe any significant difference in terms of stroke and mortality between simultaneous and staged carotid endarterectomy, however there was a significant difference in terms of hospital costs in favor of the group that underwent simultaneous surgery.

Advantages such as shorter hospitalization, lower cost, acceptable early mortality and morbidity, and reduced risk of stroke in the long term have been reported for the combined surgical approach [14]. In the light of the studies and results, we used the combined surgical technique within the same session for cardiopulmonary and carotid artery stenosis.

Carotid artery [15,16] and coronary bypass surgery [17] have acceptable mortality and morbidity rates. So that the same seansta continues to be the result of the debate whether or not to intervene.

Since cardiopulmonary bypass is performed under general anesthesia, the combination of carotid endarterectomy and cardiopulmonary bypass is also performed under general anesthesia. Although we performed the combined surgery method for carotid endarterectomy routinely under general anesthesia in previous years, now we prefer local anesthesia. This opens the veil drawn on the patient's neurological functions under general anesthesia, facilitating the follow-up [18]. So, this method allows us to observe the patient

during carotid endarterectomy and to diagnose neurological deficits that may develop during the operation. Intraoperative neurological examination is the most reliable method to determine the suitability of cerebral perfusion during application of a cross-clamp to the carotid artery. Evaluation of consciousness and speech and examination of the grip strength of the contralateral hand provide very important information [19]. We performed carotid endarterectomy under local anesthesia in the combined treatment, allowing us to observe the pre-bypass neurological functions of the patients.

Although the combined approach may seem to reduce the length of stay in the hospital and the cost in several studies due to performance of the procedure in a single session, it has been reported that using general anesthesia in the procedure increased the rates of stroke and death [20,21]. We performed the procedure under local anesthesia to minimize neurological deficits in our patients.

In this procedure (simultaneous cardiopulmonary bypass and local carotid endarterectomy), patients should be completely cooperative since they also have severe coronary artery disease. This procedure allows us to avoid undesirable outcomes that may lead to anxiety and severe intraoperative myocardial infarction [22]. Through this procedure, we have protected our patients from these complications.

Using a carotid shunt helps to perform a safer surgical intervention [23-25]. There are disadvantages such as particle embolization associated with carotid shunt use [26]. We used shunt in all of our patients in our clinic.

Conclusion

The incidence of coronary and carotid artery disease coexistence is not too low. The combined approach increases the stroke and mortality rate by using general anesthesia in the procedure, although the odds of complications appearing to reduce the duration of hospitalization with the performance of a single seansta procedure. However, local carotid artery surgery and concomitant coronary bypass reduced mortality and minimized hospitalization. Also, other advantages such as shorter hospitalization, lower cost in the long term have been reported for the combined surgical approach.

Retrospective design of the study and the inclusion of limited number of the cases were the main limitations.

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