

Combined Carotid Endarterectomy and Cardiac Surgery for Concomitant Carotid and Cardiac Disease

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Objectives: Carotid artery disease is one of the important factors of neurological complications after cardiac surgery. In this study we present our surgical experience and discuss its implication for patients with carotid and cardiac disease.

Methods: Five patients underwent combined carotid endarterectomy (CEA)/cardiac surgery including thoracic aortic repair. There were three male and two female patients, with a mean age of 67±10 years (range, 54-75 years). All patients had an 80% or greater stenosis in the unilateral internal carotid artery. Three patients had coronary artery disease and underwent combined CEA/off-pump coronary artery bypass grafting (OPCAB). One patient had an aortic valve stenosis (AS) with repeated syncope and chest pain, and underwent combined CEA/aortic valve replacement. The remaining patient had an extremely large aortic arch aneurysm (90 mm) and underwent combined CEA/total arch replacement.

Results: There were no surgical or hospital deaths. No perioperative complications including myocardial infarction and stroke occurred. During the follow-up period, lasting from 2 months to 27 months (mean, 13 months), there were no late deaths, neurological complications nor cardiac events.

Conclusions: Combined CEA/cardiac surgery offered an acceptable morbidity in these complex patients. Due to the preliminary nature of our study, further follow-up and experience with our management strategy are necessary. (*Ann Thorac Cardiovasc Surg* 2003; 9: 180-3)

Key words: carotid endarterectomy (CEA), combined, cardiac surgery, off-pump coronary artery bypass grafting (OPCAB)

Introduction

In recent studies of cardiac surgery, the overall stroke rate has been reported to be 2.0-3.6%.^{1,2} Significant carotid artery stenosis is one of the possible causes of neurological complication.³⁻⁵ The incidence of carotid artery stenosis of 70% or greater ranges from 1.3% to 8.5% in candidates of cardiac surgery.³⁻⁶ The choice of the optimal surgical management is controversial for the patients with

carotid and cardiac disease. The options of treatment include combined carotid endarterectomy (CEA) and cardiac surgery or a staged approach.⁷⁻¹⁰ Furthermore, recent off-pump coronary artery bypass grafting (OPCAB) may also have an impact on patients with significant carotid and coronary artery disease.^{4,11,12} In this study, we present our surgical experience of combined CEA/cardiac surgery including thoracic aortic repair and its implications for patients with concomitant carotid artery and cardiac disease.

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Subjects and Methods

Screening

In our Department, all candidates of cardiac surgery including thoracic aortic repair undergo magnetic resonance

Table 1. Clinical profile of five patients undergoing combined carotid endarterectomy and cardiac surgery

Case	Age	Gender	Comorbidities	Symptom	Carotid (%)	Cardiac	Surgery
1	56	M	HT	TIA	Right (85)	Coronary	OPCAB × 3 + CEA
2	73	F	HT, DM	No	Right (80)	Coronary	OPCAB × 3 + CEA
3	74	F	DM, RF	TIA	Left (80)	Coronary	OPCAB × 3 + CEA
4	54	M	HT, HC	Syncope	Left (99)	AS	AVR + CEA
5	75	M	HT, HC	Stroke	Left (95)	TAA	TAR + CEA

HT, hypertension; DM, diabetes mellitus; RF, chronic renal failure; HC, hypercholesterolemia; TIA, transient ischemic attack; AS, aortic valve stenosis; TAA, thoracic aortic aneurysm; OPCAB, off-pump coronary artery bypass; AVR, aortic valve replacement; TAR, total arch replacement.

angiography (MRA) to screen for carotid artery disease. Our criterion for CEA is a 70% or greater stenosis in the internal carotid artery. Carotid disease revealed by MRA is precisely confirmed with angiography and a duplex scan. Furthermore, cerebral blood flow is investigated using single photon emission computed tomography (SPECT), and the response of the cerebral vascular reserve is examined using acetazolamide loading brain scintigraphy.

Patients

Between October 15, 1997 and November 10, 2002, 252 cardiac surgeries including OPCAB and 30 CEAs were performed in Ehime University Hospital. Five (2.0% of cardiac surgery, and 16.7% of CEA) patients underwent combined CEA/cardiac surgery. There were three male and two female patients, with a mean age of 67 ± 10 years (range, 54-75 years). One patient was asymptomatic, and 4 had a history of stroke (n=1), syncope (n=1), or transient ischemic attack (n=2). Comorbid conditions included: hypertension (n=4); diabetes mellitus (n=2); hypercholesterolemia (n=2); and chronic renal failure (n=1). All patients had an 80% or greater stenosis in the unilateral internal carotid artery. In all patients, bilateral mean cerebral blood flow in SPECT showed more than 30 ml/100 g/min. Acetazolamide loading scintigrams showed an acceptable cerebral vascular reserve and no steal phenomenon. Three patients had coronary artery disease. Two of these three patients had significant left main trunk disease. Another patient had an aortic valve stenosis (AS) with repeated chest pain and syncope. The remaining patient had an extremely large aortic arch aneurysm (90 mm in diameter). Data on these patients were collected from chart reviews and direct contact with the patients.

All three patients with coronary artery disease underwent combined CEA/OPCAB. The patient with an AS

had a combined CEA/aortic valve replacement. The patient with an aortic arch aneurysm underwent a combined CEA/total arch replacement (Table 1).

Results

There were no surgical or hospital deaths. The length of operation, including set-up of cardiac surgery after CEA averaged 701 ± 63 minutes. The postoperative length of stay in the intensive care unit averaged 4.8 ± 2.4 days (range, 2 to 8 days). No neurological complications or myocardial infarctions occurred. One patient had cardiac tamponade which required re-exploration on postoperative day 5. No neck or sternal wound problems developed. Postoperative MRA or angiography showed good results of endarterectomy. SPECT showed improved cerebral blood flow. One patient who underwent combined CEA/OPCAB required percutaneous coronary intervention of the right coronary artery because of a closed bypass. During the follow-up period that lasted from 2 months to 28 months (mean, 13 months), there were no late deaths, neurological complications nor cardiac events (Table 2).

Discussion

We experienced acceptable results in combined CEA/cardiac surgery including OPCAB. There is still controversy about the management of patients with carotid artery and cardiac disease (both coronary disease and non-coronary disease). However, myocardial infarction has been reported to be the most frequent cause of perioperative and late death after CEA.^{13,14} The guideline for CEA from American Heart Association has shown the rate of myocardial infarction after CEA was 11.5% in patients undergoing staged CEA/coronary artery bypass.¹⁴ There-

Table 2. Operative results and postoperative complications

Case	Length of the operation (min)	ICU stay (days)	Cardiac complication	Neurological complication	Follow-up (months)
1	730	2	No	No	14
2	770	5	Tamponade	No	13
3	690	7	No	No	10
4	600	2	No	No	2
5	715	8	No	No	28

ICU, intensive care unit.

fore, many investigators have shown growing appreciation that combined CEA/coronary artery bypass can be the preferred approach to avoid myocardial infarction.^{7,8,10,15} Akins and colleagues published that the rate of mortality, stroke, and myocardial infarction were 3.5%, 3.0%, and 2.5%, respectively, in patients with 200 consecutive combined CEA/coronary artery bypass operations.⁷ Char and colleagues reported that the freedom from late neurological events was $98\pm 1.3\%$ and the freedom from late cardiac events was $82\pm 4.6\%$ at five years in 154 patients undergoing combined CEA/coronary artery bypass.⁸

Meanwhile, few reports are available on combined CEA/non-coronary cardiac surgery.¹⁶ We experienced two patients undergoing combined CEA/non-coronary cardiac surgery. One had AS with repeated chest pain and syncope. The other had a large aortic arch aneurysm (90 mm). This may have lead to a deterioration of the patient's hemodynamic status such as heart failure or aortic rupture resulting in sudden death after CEA, if a staged procedure was selected. Therefore, we believe these patients should be treated with a combined procedure.

In patients whose cerebral blood flow and the cerebral vascular reserve are severely reduced (cerebral blood flow <80% of anticipated normal value in SPECT, and with the steal phenomenon in acetazolamide loading cerebral scintigraphy), hyperperfusion syndrome post-CEA is of great concern.^{17,18} In such patients, their level of consciousness and other neurological parameters should be monitored immediately after CEA. Furthermore, treatment should be initiated to prevent cerebral edema if hyperperfusion syndrome occurs. Therefore, in such patients, the combined procedure under the same anesthesia should be avoided, since this approach permits neither adequate monitoring of consciousness nor its treatment immediately after CEA.

We believe that combined CEA/OPCAB is the most

appropriate for significant carotid and coronary artery disease, because OPCAB carries several benefits compared with conventional on-pump coronary artery bypass grafting. First, the risk of embolism from the aortic source is potentially reduced since aortic manipulation is minimized. Second, the off-pump procedure may eliminate some of the potential untoward effects of cardiopulmonary bypass circulation (nonpulsatile flow, systemic inflammatory response, low flow phenomenon, low arterial pressure, and so on). Especially in patients undergoing combined CEA/cardiac surgery, to avoid nonpulsatile circulation is of great advantage, because their autoregulation system of cerebral circulation might be disordered. Finally, the costs and hospitalization for an additional operation are avoided. There have been only two reports about combined CEA/OPCAB despite the recent worldwide introduction of OPCAB.^{4,11} Meharwal and colleagues reported good results of 82 patients undergoing combined CEA/OPCAB. In their report, there were no operative deaths; 1 transient ischemic attack and 1 myocardial infarction.⁴

On the other hand, some surgeons believe that it is unnecessary to perform combined CEA/OPCAB for patients with coronary and "asymptomatic" carotid artery disease, because OPCAB has a lower rate of neurological complication.^{12,19} According to the Asymptomatic Carotid Disease Study,²⁰ the risk of stroke in patients with asymptomatic carotid disease is 2% per year and prophylactic CEA did not show any significant benefits. Therefore, CEA was not recommended in the "asymptomatic" group of patients. However, this study's data was obtained from patients who are not candidates of cardiac surgery. Every cardiac surgery has potential risks of neurological complication. Even OPCAB may cause hemodynamic collapse because of myocardial ischemia, mechanical problems, or a combination of both.²¹ Furthermore, Mariani and colleagues reported that coagulability is ac-

celerated after OPCAB, and it might adversely affect cerebral circulation.²²⁾ Therefore, we believe that combined CEA/OPCAB has advantages with respect to neurological protection in all candidates with a 70% or greater stenosis in the carotid artery, whether symptomatic or asymptomatic.

For patients with a high neurological risk and a high cardiac risk, various alternative options are available. In fact, remarkable progress has recently been made in the development of interventions such as stent placement for carotid artery disease.²³⁾ Transluminal carotid angioplasty with a stent followed by cardiac surgery can be advocated as one of the possible choices for these patients, although its efficacy is yet unproven.

Conclusion

Combined CEA/cardiac surgery including OPCAB offered an acceptable morbidity for complex patients. Due to the preliminary nature of our study, further follow-up and experience with our management strategy are necessary.

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