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A Retrospective Study of Combined Cardiac and Carotid Surgery

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Abstract

Introduction: A combined carotid endarterectomy (CEA) and cardiac procedure has higher early risk of stroke than isolated CEA because of the widespread atherosclerosis in patients selected for simultaneous procedures. In this retrospective study, we review the results of combined coronary artery bypass grafting (CABG) and carotid endarterectomy (CEA) procedures.

Materials and methods: Between January 2000 and December 2007, 91 patients with a mean age of 69.2+6.6 (24/67 female/male) underwent combined operations (CEA-CABG) on cardiopulmonary bypass (CPB) as elective surgery. The study population was divided, as follows: *Group A:* 83 patients (91.2%) had both venous and arterial revascularization; *Group B:* 8 patients (8.8%) had total arterial revascularization. CEA was performed in case of stenosis more than 80% and always before cardiac operation. These techniques were used: standard procedure (54.8%), eversion (39.2%), patch enlargement (6%). Immediately after the vascular procedure, CABGs were performed through median sternotomy. The mean EUROscore was 6.9+2.5%.

Results: All neurological complications were in the group who underwent both venous and arterial revascularization (Group A), where a proximal anastomosis was made. All complications and deaths were in group A. Six patients had stroke (6.6%) and 2 had acute myocardial infarction (AMI) (2.2%). There were 8 in-hospital deaths (8.8%) and 1 late death (for stroke after five months).

Conclusions: In our center, the incidence of stroke in simultaneous cardiovascular procedures was 5.5 times greater than in isolated cardiac or vascular procedures, which was probably related to the widespread vessels disease. An aortic cross clamp and surgical procedure on the ascending aorta are relevant risk factors for developing neurological events; much attention should be paid to aortic manipulation. In the sub-group who underwent total arterial revascularization with associated CEA procedures, we had no neurological events. A partial cross clamp and proximal anastomosis are relevant risk factors for developing neurological events. Therefore, in combined operations (CEA associated with CABG), it is probably more favourable performing a total arterial revascularization, avoiding partial ascending aortic clamping.

Key words: *Carotid endoarterectomy, coronary artery by-pass grafting*

Introduction

The mortality rate and the risk of neurological complications after simultaneous carotid endarterectomy (CEA)/ coronary artery bypass grafting (CABG) are higher than the isolated procedures, mainly because of the widespread atherosclerosis [1]. There is a well-known relation of the risk of an embolism and the atherosclerosis of the ascending aorta in patients who died after

CABG: the brain is the most common target of embolization [2,3]. There is agreement in literature that more than 10% of patients who had undergone CABG had simultaneous carotid stenosis ≥ 80% (sec. ECST), while about 50% of the patients who underwent CEA had coronary artery disease [4-9]. However, the question about the optimal timing of a surgical approach for patients with concomitant carotid and cardiac disease is ongoing. In order to evaluate the risk of neurological complications due to the aortic manipulation, we compare the outcome of patients with and without partial aortic clamping for proximal anastomosis. We present our experience of combined surgery.

Material and methods

Between January 2000 and December 2007, we have performed approximately 2000 isolated CEA and more than 2000 CABG (isolated or associated). Ninety-one patients (24 females, mean age 69.2 + 6.6) underwent combined operations (CEA associated with CABG) on extracorporeal circulation (ECC): no cases of emergency surgery have been considered. All patients scheduled for CABG were preoperatively assessed by a carotid echo-color Doppler, regardless of neurological symptoms or previous stroke. CEA was planned in case of carotid stenosis ≥ 80% (sec. ECST). Proximal vein anastomosis was made with a partial ascending aortic clamp.

All the patients were operated on under general anesthesia and CEA was always performed before CABG. The mean number of grafts was 3.3+0.8. CEA was performed in case of stenosis more than 80% (the degree of stenosis was determined by measurements obtained by the European Carotid Surgery Trial method). The cerebral status was monitored by checking the stump pressure, and in case of stump pressure ≤50 mmHG, a Pruitt-Inahara shunt was positioned (in 30.5% of cases). The shunt was used to ensure an adequate cerebral perfusion during CEA. In the authors' experience [10,11], the shunt use reduced the incidence of stroke rate during CEA, and the insertion rate is not influenced by the contralateral carotid occlusion. Moreover, in this series only the 5.4% presented a contralateral ICA occlusion. The median carotid clamping time was 38.0+13.8 minutes. These surgical techniques for CEA were: direct suture (54.8%), eversion (39.2%), patch enlargement (6%).

In order to evaluate the role of the aortic manipulation for proximal anastomosis, we have divided the study population, as follows: *Group A:* 83 patients (91.2%) had both venous and arterial revascularization; *Group B:* 8 patients (8.8%) had total arterial revascularization.

In total, the mean population additive EuroScore was 6.9 + 2.5; the mean EF was 50.8 + 10 and the mean age was 69.2 + 6.6. Preoperative characteristics are summarized in table 1.

Table 1: Preoperative characteristic of patients.

	TP (91 pt.)	Group B (8 pt.)	Group A (83 pt.)
Mean Age in years	69.2 ± 6.6	65.4 ± 7.28	69.57± 6.47
EF %	50.8 ±10	48.1 ±10.67	51 ± 10.6
Additive EuroScore	6.9 ± 2.5	6.9 ± 3.2	7 ± 2.42

EF: ejection fraction; TP: total patients.

Results

Postoperative characteristics are summarized in tables 2-3.

In total, the population X-Clamp time was 96.2 + 35.6 min; the total bleeding was 657 + 363.2 ml and intensive care stay was 3 + 3.2 days.

Table 2: Postoperative data.

	TP (91 pt.)	Group B	Group A
ECC min.	96.2 + 35.6	66.9 + 47.8	99 + 35.2
Cross clamp time (min.).	63.42 + 26	47.8 + 28.47	64.9 + 25.4
Intubation time (h)	34.8 + 55.6	22.8 + 15.4	36.05 + 58.07
Bleeding (ml)	657 + 363.2	641 + 367.98	658.6 + 365
Hospital stay (days)	10.6 + 7.14	7.8 + 1.48	10.78 + 7.36
Intensive Care Unit stay (days)	3 + 3.2	1.8 + 0.46	3.14 + 3.41

h: hours; min: minutes; ECC: extracorporeal circulation; TP: total patients.

Table 3: Mean of CABGs/patients.

	BP/PTs Mean
Group A	3.3 + 0.8
Group B	2.6 + 1.1

All neurological complications were in the group who underwent both venous and arterial revascularization (Group A), where a proximal anastomosis was made. All complications and deaths were in group A.

Postoperative complications were summarized in table 4, as follows: 6 strokes (6.6%; the stroke of carotid origin was 2.1%), 2 acute myocardial infarctions (AMI) (2.2%), 1 neck and 7 mediastinal re-explorations for bleeding (8.8%), 4 multiorgan failures (MOF), 5 respiratory failures, 7 renal failures, 1 intestinal infarction, 8 malignant arrhythmias, 1 pneumonia, 8 hemodynamic instabilities requiring IABP insertion and drug administration.

Table 4: Postoperative complications.

	TP (91 pt.)	Group B (8 pt.)	Group A (83 pt.)
MOF	4	0	4
Re-intubation	5	0	5
Neurological events	6	0	6
Renal failure	7	0	7
AMI	2	0	2
IABP	6	0	6
Malignant arrhythmias	8	0	8
Inotropic support	8	0	8
Intestinal infarction	1	0	1
Re-exploration for bleeding	7	0	7
Infection	1	0	1
Death	9	0	9

MOF: multiorgan failure; AMI: acute myocardial infarction; IABP: intraaortic balloon pump; TP: total patients.

There were 8 in-hospital deaths (8.8%) and 1 late death (for a stroke after five months). Causes of in-hospital death were summarized in table 5, as follows: 1 intestinal infarction (1.1%), 2 cardiac-related deaths (2.2%) (1 AMI, 1 malignant arrhythmias), 2 neurological events (3.3%), 3 MOF (3.3%).

Table 5: Causes of death.

Causes of death	Hospital mortality (n. pt)	Late mortality (n. pt)
MOF	3	0
Neurological	2	1
cardio-related	2	0
Intestinal-infarction	1	0

MOF: multiorgan failure.

Discussion

The higher risk of neurological events, in case of carotid pathology, is already well established: the question about the optimal timing for a surgical approach, in case of simultaneous carotid and cardiac diseases, is still controversial because of the disagreement of the data reported.

The risk of neurological events in patients who underwent a combined procedure is related to anatomical characteristics and surgical procedures. For the anatomical characteristics, the degree of carotid stenosis is one of the most important causes of stroke during CABG: in fact, for patients with stenosis < 50%, the incidence of significant neurological events was 9.2%, compared with 1.9% in patients with normal carotid arteries. Secondly, the aortic arch disease is an independent predictor of postoperative stroke [12]. Patients with severe aortic arch disease have a 5% to 19% risk of neurological complications, compared with 0% to 2% in patients with normal aortic arches. It has also been convincingly demonstrated that the degree of aortic manipulation at the time of surgery directly influences postoperative stroke rates independent of aortic atherosclerosis [12].

For the surgical-related complications, the embolism for aortic manipulation is one of the strongest causes of neurological complications. On this basis, many questions are made about the possibility of reducing the incidence of stroke in cases of a combined procedure; unfortunately, the anatomical characteristics are not modifiable and only the surgical approaches can be discussed. In fact, many strategies have been proposed to reduce the incidence of stroke and optimize the outcome. These included: CEA followed by CABG, with a lower incidence of stroke but a higher rate of cardiac events; CABG followed by CEA, with a higher incidence of neurological events but fewer cardiac complications; synchronous procedures, which have medium incidences of both complications [12].

The negative effects of the ECC time and aortic manipulation on the neurological complications have been clearly demonstrated. Even in our experience, patients without aortic manipulation for proximal vein anastomosis have a lower incidence of neurological injuries. In fact, Group B, who received a total arterial

revascularization (without anastomosis on the ascending aorta), seemed to be protected against neurological complications. Thus, total arterial revascularization should be considered as a strategy to prevent neurological injuries in patients who have undergone combined CEC and CABGs.

Synchronous CEA/CABG offers the economic benefit of avoiding two separate procedures and hospitalizations, with an acceptable risk of complication and good long-term freedom from coronary and neurologic events. A single occluded carotid conferred a 15.6% risk of stroke, and patients with bilateral carotid occlusions had a 33% incidence [9-12].

However, the best approach to the management of concomitant severe carotid and coronary artery disease remains unanswered. The American College of Cardiology/American Heart Association (ACC/AHA) guidelines recommend CEA in asymptomatic carotid stenosis of ≥ 80%, either prior to or combined with CABG (Class IIa Carotid endarterectomy is probably recommended before CABG or concomitant to CABG in patients with a symptomatic carotid stenosis or in asymptomatic patients with unilateral or bilateral internal carotid stenosis of 80% or more - Level of Evidence: C). Moreover, carotid screening is probably indicated in the following subsets: age greater than 65 years, left main coronary stenosis, peripheral vascular disease, history of smoking, history of transient ischemic attack or stroke, or carotid bruit on examination - Level of Evidence: C [13].

However, there is no consensus as to which surgical approach is superior. More recently, carotid artery stenting (CAS) prior to CABG is emerging as an alternative option with promising results in asymptomatic patients considered 'high risk' for CEA, even though the late outcome is uncertain [14].

Conclusions

The major limitation of this study concerns the small number of patients considered and the risk of bias in case of a retrospective study.

However, our experience may be helpful for clinicians involved in the care of this high-risk subset of patients.

In conclusion, our study confirms that in cases of CEA/CABG combined procedures using ECC and aortic cross clamping, every effort must be made in order to reduce the aortic manipulation and the atheroembolisms; on this basis, it is to avoid both a partial ascending aortic clamp and venous revascularization to reduce the risk of neurological complications, due to an unstable clamping way, and also to the proximal anastomosis confectioning. In our series, there is strong evidence that complete arterial revascularization could be useful in reducing the incidence of stroke for patients undergoing a combined procedure. Therefore, in our center an arterial revascularization is also used in older patients that have to be operated on in CEA/CABG combined procedures.

We are aware that small numbers cannot provide a definitive conclusion but could offer a matter for speculation. The aim of this paper is to present personal experience, pointing out that the risk of complications in cases of combined CEA/CABG is high. Further analysis is required to clarify the matter of the ideal surgical management, even though our experience confirms that combined surgery is affected by high risk of acute complication with the following high rate of event-free survival.

Conflict of interest statement

The authors do not declare any conflict of interest or financial support in this study.

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