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SIMULTANEOUS TREATMENT OF CAROTID AND CORONARY ARTERY DISEASE: CURRENT CONCEPT AND RESULTS OVER THE PAST 5 YEARS

SUMMARY

Combined carotid artery endarterectomy and coronary artery bypass grafting (C-CABG) has been identified as having a high perioperative risk. Therefore, carotid artery stenting has been recommended. Missing level I evidence concerning C-CABG and carotid stenting have motivated us to review our experience over the past 5 years in C-CABG. Single centre retrospective study of 113 C-CABG was performed between January 2000 and December 2004. Mean age of the patients was 65 years (22 patients were 80 years old or older). Carotid endarterectomy was performed first in the same narcosis. Thirty day mortality was 4.4% (5/113), with no neurological death. Overall neurological complication rate was 3.5% (4/113) due to one stroke that resolved within 30 days and three TIA's. C-CABG, with carotid endarterectomy performed first, is a safe technique with a low stroke rate. The risky part of the C-CABG is not the carotid intervention itself, but the CABG procedure. Therefore, as long as single carotid artery stenting has not clearly shown early and/or long-term advantages over carotid endarterectomy, it does not seem to be justified in C-CABG.

Key words: **carotid artery, endarterectomy, coronary artery, bypass grafting**

INTRODUCTION

With the introduction of carotid artery stenting (1,2), especially in the so-called high-risk patient, presenting combined carotid artery stenosis (CAS) and coronary artery disease (CAD), a new debate inflamed, and surgical practice was the one that could change something in the near future. It is already recommended to perform first CAS stenting in that high-risk population, followed by a surgery-free period of up to 6 weeks in order to avoid acute stent thrombosis (reported when surgery is performed soon after CAS stenting) (3,4). In regard to that issue, combined coronary and carotid surgery offers the advantage to correct both diseases simultaneously, protecting patients against complications that can occur due to the coexisting untreated carotid or coronary subsystem. Since its introduction in the seventies by Bernhard (5), the combined surgical approach to coronary and carotid arteries has predominantly shown beneficial results. Nowadays, older patients or patients with more progressive diseases are treated. Have we failed to recognize an increased risk during the recent years? To answer that question, we have decided to analyze our experience in the simultaneous surgical treatment of CAS and CAD over the past five years.

METHODS

Single center retrospective study of all combined CEA and CABG (C-CABG) procedures was performed between January 2000 and December

2004. During that period, a total of 3515 cardiac procedures was performed: 213/3515 (6%) combined cardiac and vascular procedures, whereof 113/213 (52%) CABG and CEA procedures. CEA was equally distributed on the right and left side (50%).

Mean age of the patients in the C-CABG group was 65 years (mean: 68y +/-10y, min 31y, max 89y). Twenty two patients were 80 years old or older.

Indication for C-CABG

Patients referred for CEA and presenting risk-factors for CAD such as cardiovascular risk-factors, angina pectoris and/or a history of myocardial infarction were prospectively screened by myocardial scintigraphy (MS) and/or coronary angiography.

Patients referred for a CABG procedure and presenting suspicion of CAS such as TIA or history of stroke, carotid bruits or age>70 years, were prospectively screened by duplex-sonography and/or transcranial Doppler.

In patients with an acute stroke, a delay for surgery of three weeks was demanded to avoid hemorrhagic complication of the systemic heparinization necessary for surgery. Also, cerebrovascular CT scan or MRI study for exact assessment of the lesions were required.

Bilateral CEA was considered to be inappropriate, because of the risk of a cerebral hyper-perfusion syndrome and postoperative airway and swallowing difficulties. If necessary, bilateral CEA has been carried out in a staged way, performing the contralateral CEA 6 weeks after first combined intervention.

Indication for CEA (Table 1)

In patients with symptomatic CAS, indication for CEA was given when stenosis was >70% or when aspect of plaques was highly suspect, independently of contra-lateral carotid artery disease. In patients with asymptomatic CAS, indication for CEA was given when stenosis was >80%, or less when the contra-lateral carotid artery was diseased.

Table 1. CAS symptoms

	Occurrences	Percentage
Asymptomatic	78	69
Amaurosis fugax	2	1.8
TIA	15	13.2
RIND	1	0.9
Stroke in regression	9	8
Stroke with fixed deficits	8	7.1

Indication for CABG (Table 2–8)

CABG was considered when stress test was positive despite of maximal medical treatment, and coronary lesions were not amenable by PTCA.

Table 2. CAD symptoms

CCS	Occurrences	Percentage
I	32	28.3
II	34	30.1
III	35	31
IV	12	10.6

Table 3. Indications for CABG

	Occurrences	Percentage
Elective	86	76.1
AMI	11	9.7
Unstable AP	10	8.8
Heart insufficiency	1	0.9
Other non-elective	5	4.4

Table 4. Timing of CABG

	Occurrences	Percentage
Elective	86	76.1
Urgent	26	23
Emergent*	1	0.9
* failed PTCA		

Table 5. CAD LV ejection fraction

	Occurrences	Percentage
Normal (>51%)	76	67.3
Reduced (30–50%)	30	26.5
Low (<30%)	7	6.2

Table 6. CAD extent

	Occurrences	Percentage
1 vessel	9	8.0
2 vessels	17	15.0
3 vessels	87	77.0

Table 7. CAD left main disease

	Occurrences	Percentage
No LMD	83	73.5
Stenosis <49%	6	5.3
Stenosis >50 %	24	21.2

Table 8. Euroscore as risk stratification

	Occurrences	Percentage
1-5	36	31.9
6-10	52	46
11-15	21	18.6
16-20	3	2.7
21-25	1	0.9

SURGERY

Surgical strategy was based on a one-step (simultaneous) C-CABG procedure within the same narcosis to avoid detrimental peri- and postoperative complications of the untreated coronary or cerebrovascular subsystem. CEA was performed first, in order to circumvent cerebral hypoperfusion during CABG procedure.

Carotid endarterectomy

All the combined cases are performed under general anaesthesia using a protective endoluminal carotid artery shunt for CEA. The shunt was gently inserted distally into the internal carotid artery first to avoid misplacement or vessel wall lesion and backflow carefully observed as an assessment of tube patency, before carrying out the endarterectomy. Basically, three different techniques have been employed for vessel closure. Patchplasty (40%) especially in trainees cases, direct closure technique (5%) or the bifurcationplasty (6), which is the preferred and most used technique in our hands. Definitive wound closure was performed at the end of CABG. Thrombosis-prophylaxis was achieved with heparin bolus administration (5000IE) before vessel clamping and aspirin bolus (100mg) before declamping. Heparin was not antagonized, as it is mandatory for coronary surgery. Furthermore, protamine might induce pulmonary hypertension and systemic hypotension, not well tolerated in coronary insufficiency.

Coronary artery bypass grafting

During the last five years, CABG has been performed with different protocols. Most of the patients have been operated on with cardiopulmonary bypass (mild hypothermia: 30 degrees, or normothermia), standard aortic cross-clamping and cardioplegic arrest. But, a growing number of cases have been performed without cardiopulmonary bypass (OPCAB). Bypass conduit included at least one internal mammary artery, combined with one or two saphenous vein grafts. Overall, median number of distal coronary anastomoses was 3 (mean +/- SD: 3.2+/-1.5, min: 1, max: 7). After completion of proximal anastomoses, and weaning of cardiopulmonary bypass when used, heparin was completely reverted.

80% of the interventions have been performed by experienced surgeons, 20% by cardiovascular trainees.

Postoperative management and controls

Postoperative arterial thrombosis-prophylaxis included aspirin 100mg and 15000 U of heparin daily. Since the beginning of 2004, aspirin has been routinely combined with clopidogrel (Plavix®: loading dosis of 300mg then 75mg/day) to achieve a more effective platelet inhibition after CABG procedures. Postoperative carotid duplex sonography was performed in all patients before discharge by an independent lab. In the case of stroke, TIA or suspicion of neurological deficit, a neurologist was involved. When stroke occurred, CT or MRI studies were performed to assess cerebral deficit and neurological outcome.

RESULTS

30-day mortality was 4.4% (5/113), with none of the deaths being of neurological nature. Stroke occurred in 1 patient (0.8%, ipsilateral), but symptoms resolved completely within 30 days. TIA occurred in 3 patients (2.6%). The overall neurological complication rate was 3.5% (4/113). Local complications of CEA were: wound haematoma (5%, 6/113), cranial nerve dysfunction (6%, 7/113) or wound healing problems (4.5%, 5/113). Redo CEA was never necessary as postoperative carotid duplex sonography showed an excellent (no residual stenosis) or satisfying result (stenosis< 50%) in all patients.

DISCUSSION

Carotid and coronary artery disease commonly coexist. Prevalence of CAS amongst patients undergoing CABG has been reported to be about 10-15% (7,8) and prevalence of CAD amongst pa-

tients undergoing CEA is up to 50% (9). Treatment intention in patients having CAD or CAS or coexisting CAS and CAD remains the same: to achieve a better outcome by a reduction of the disease associated acute and long-term morbidity and mortality (10). This holds true even for elderly patients, where recovery and rehabilitation after a stroke or myocardial infarction are severely limited, and socio-economic consequences often dramatic.

A net benefit of isolated CEA has been shown in four randomized controlled trials; for symptomatic patients with stenosis higher than 50% (ECST, NASCET) (11-13) and asymptomatic patients with stenosis higher 60% (ACAS, ACST) (14,15). CABG has been well studied for the last 5 decades and is nowadays generally performed in patients not amenable for PTCA, especially in patients with a coronary 3-vessel disease (i.e. left main equivalent and RCA disease) and reduced heart function or when left main is diseased.

Concerning coexisting CAS and CAD, several treatment options have been described. In acute presentation, the symptomatic lesion is usually given priority for surgical treatment, whereas in the elective case, the reason for referral usually determines the mode of management. Brener at al. (16) showed in a series of 2000 isolated CABG procedures with preoperative non-invasive carotid assessment a stroke rate of 15% in patients with CAS in contrast to 1.9% in the absence of CAS. In patients with documented coexisting disease, who underwent staged procedures, a stroke or TIA rate of up to 9.2% was noted when CABG proceeded CEA. On the other hand, isolated CEA in patients with documented CAD shows a peri-operative mortality of 18% and myocardial infarction rate of about 13% (16). Combined CEA and CABG has first been described by Bernhard 1972 (5). In that initial series a net benefit could be detected for C-CABG with results equal to CABG alone. These results have been confirmed by many other authors. Concerning the staged approach, Lawrie (17) showed that the most appropriate strategy would be that of CABG first, with a mortality rate of 1.2% compared to CEA first (mortality of 18%) (18). But other authors have presented satisfying results with the staged CEA first approach, especially when performed under local anaesthesia (19), followed by a standard CABG procedure later on.

In a systematic review of outcomes following staged and synchronous carotid endarterectomy and coronary artery bypass including 97 published studies following 8972 staged or simultaneous procedures no significant difference in outcomes for staged and simultaneous procedures was found (20). However, the patient groups included in the overall and paired analysis seem not to be really comparable as for example. One of the largest series reporting both staged and simultaneous procedures finds that unstable and/or urgent cases tended to undergo simultaneous operation, whereas staged interventions were done in the less severe cases, thus biasing the results (2).

Carotid artery stenting has now been proposed as an alternative to CEA in the so-called high-risk patient, presenting with coexisting CAS and CAD (21,22). Is that justified? It would be, if the stroke would be the main complication of C-CABG and if carotid artery stenting produced clearly better results. Looking at our experience of C-CABG over the past five years, we can not answer that question affirmatively. Indication for surgery has evolved in both carotid and coronary artery disease over the last decades to more severe diseases. Despite that, neurologic complication rate remained invariably low in our practice (3.5%; 4/113). In the last five years, C-CABG have been performed significantly more often in asymptomatic CAS (78% in regard to 24% in the nineties (10)), where the complication rate has to be ultimately low, to procure any benefit over natural disease course. In the past, most of the CEA concerned symptomatic CAS (23), where even with a higher perioperative complication rate, overall benefit of the CEA procedure remained guaranteed. Moreover, nowadays more complex coronary revascularizations are necessary in C-CABG. Patients referred to the surgeons are mostly those that do not, or no more fit for PTCA. In such cases native vessels are very small and/or disease already very diffuse, so that coronary anastomoses have to be placed very distally, making CABG surgery challenging. Additionally, left ventricular function seems to be poorer than in the past. Consecutively, surgical risk of C-CABG has increased.

Interestingly and as highlighted in our series, the risky part of the C-CABG is not the carotid intervention itself, but the CABG procedure showing results clearly worse than these of isolated CABG in the absence of CAS. The following strategies can be used to reduce cardiac complications of coronary revascularization in C-CABG: 1. percutaneous coronary angioplasty. 2. off-pump coronary surgery (OPC ABG; without cardiopulmonary bypass machine). 3. beating heart coronary surgery (CABG with cardiopulmonary bypass machine, but without cardioplegic heart arrest). The common factor of these techniques is, that coronary revascularization can be performed without cardioplegic arrest, thus reducing ischsssssemia and reperfusion injury, which are responsible for acute heart failure, and ameliorating cardiac outcome.

CONCLUSIONS

C-CABG, with CEA performed first, is still a safe technique with a low stroke rate. The overall risk of C-CABG has not changed in comparison with earlier series. Perioperative stroke rate seems to have decreased, probably because more asymptomatic carotid artery stenosis patients are treated today. On the contrary, CABG risk seems to have increased, probably because patients with coexisting CAS and CAD do nowadays present a more extensive coronary disease. CEA combined with PTCA might be an attractive option to reduce CAD complications in patients where CABG might be risky.

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ISTOVREMENO LEČENJE KAROTIDNE I KORONARNE OKLUZIVNE BOLESTI: SAVREMENI STAVOVI I PETOGODIŠNJI REZULTATI

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SAŽETAK

Istovremena karotidna endartektomija i aorto-koronarni bajpas (K-AKBP) su opterećeni visokim perioperalivnim rizikom. Zbog toga se u cilju lečenja karotidne okluzivne bolesti sve više primenjuje postavljanje karotidnog stenta. Nedostatak dokaza naučnog stepena sigurnosti i kod bolesnika lečenih K-AKBP sa postavljanjem karotidnog stenta bili su povod da prikažemo naše petogodišnje iskustvo u simultanom lečenju karotidne i koronarne okluzivne bolesti. Retrospektivna studija jednog kardiovaskularnog centra obuhvatila je 113 bolesnika simultano operisanih zbog udružene karotidne i koronarne okluzivne bolesti u periodu od januara 2000. godine do decembra 2004. godine. Prosečna starost bolesnika je 65 godina (22 bolesnika stariji od 80 godina). Aorto-koronarnom bajpasu je prethodila karotidna endarterektomija u toku iste anestezije. Unutar 30 dana mortalitet je iznosio 4.4 %(5/113), pri čemu nije bilo smrtnog ishoda kao posledica neurološkog deficita. Ukupno neuroloških komplikacija je bilo 3.5% (4/113), kao posledиea jednog moždanog udara (povukao se za trideset dana) i tri TIA. Istovremeno lečenje karotidne i koronarne okluzivne bolesti, gde se najpre uradi karotidna endarterektomija, a nakon toga AKBP, jeste sigurna metoda opterećena niskom perioperativnom učestalošću moždanog udara. Rizik kod istovremene karotidne i AKBP operacije je posledica AKBP-a, a ne karotidne endarterektomije. Kako, za sada, postavljenje karotidnog stenta nije pokazalo jasno bolje rane i udaljene rezultate od karotidne endartektomije, njegova primena kod istovremenog lečenja karotidne i koronarne okluzivne bolesti izgleda da neće doneti mnogo koristi.

***Ključne reči*: karotidna endarterektomija, aorto-koronarni bajpas.**