Asymptomatic carotid stenosis in patients undergoing major cardiac surgery: can percutaneous carotid angioplasty be an alternative?

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Abstract

Objective: As the mortality associated with coronary artery bypass grafts has fallen, morbidity has become an increasing problem. The improvement of transluminal carotid angioplasty is enlarged to patients with asymptomatic severe carotid stenosis (> 85%) requiring coronary surgery.

Methods: Between January 1993 and January 1995, 10 patients underwent percutaneous carotid angioplasty prior to cardiac surgery (17.4 days). Mean age was 71 ± 4.3 years. Four patients showed a contralateral occlusion of the internal carotid artery. Transluminal carotid angioplasty was carried out with a triple coaxial catheter system. Six angioplasties required a Strecker stent.

Results: Mean follow-up was 11.4 months. No mortality was observed. Only one patient showed a transient hemianopsia. All patients underwent angiography at four months. Two patients required a new procedure of carotid angioplasty completed with a Strecker stent in one case and by dilatation of a stent in another patient.

Conclusion: The results of transluminal carotid angioplasty, in this short series, are encouraging in this group of high-risk morbidity and mortality (elderly patients, bilateral carotid lesions, multiple coronary arterial grafts). © 1997 Elsevier Science B.V.

Keywords: Transluminal carotid angioplasty; Coronary surgery; Cerebrovascular stroke

1. Introduction

The therapeutic strategy to severe asymptomatic carotid stenosis for patients requiring coronary surgery is unclear as there is a lack of appropriately controlled prospective and randomized clinical trials [3, 7]. Prophylactic carotid endarterectomy is often recommended for patients with asymptomatic but hemodynamically significant carotid stenosis, especially those having major cardiac surgery, on the assumption that these patients are at increased risk for cerebral ischemia of hemodynamic cause [13]. This is a high-risk group since the combined rate of morbidity and mortality (CRMM) is more than 10% [1, 14, 28]. Extension of open heart surgery to elderly patients (> 75 years), use of arterial grafts, maximal coronary revascularization and rising rate of redo operation increase CMMR. Complications are mainly neurological events and perioperative myocardial infarction [4, 5]. Morbidity associated with haemorrhagic complications, sustained intubation time due to a combined carotid–coronary procedure, are unsteady. The improvement of intravascular dilatation techniques of supra-aortic arteries [11] allows to propose for patients requiring CABG and presenting an asymptomatic stenosis of the carotid arteries detected by screening, a new alternative therapy: transluminal carotid angioplasty (TCA). This was performed prior to the coronary procedure. It simplified the operative procedure and has reduced the CMMR.

2. Patients and methods

The studied population included ten consecutive patients who underwent TCA of the internal carotid...
artery (ICA) prior to CABG over a period of 25 months from January 1st 1993 to January 31st 1995 at CAEN University Hospital. This procedure represented less than 1% of the 1195 open heart surgeries performed during this same period (it represents the total amount of patients with asymptomatic significant ICA lesions and open heart surgery in stable patients). Unstable angina and symptomatic carotid patients were excluded from the study. Patient agreement was always obtained. All patients were male. Mean age was 71 ± 4.3 years, from 65 to 79 years. All patients had stable angina, two patients had a New York Heart Association (NYHA) class III angina and the other eight patients were in class II. One patient showed scar from an antero-apical myocardial infarction as a ventricular aneurysm. Another one presented an aortic valve stenosis. During the preoperative screening, a Doppler study of the supra-aortic arteries was systematically performed to assess internal mammary arteries. CABG were performed only with arterial grafts. Four patients showed a contralateral occlusion of the ICA. A patient underwent surgery on the contralateral ICA five years ago. All patients showed arterial hypertension. Neuropsychological tests by a medical expert were mandatory for all patients.

2.1. Clinical data

Physical examination revealed a cervical murmur in seven patients. No history of stroke was found. Two patients had arterial lesions related to superficial femoral stenosis. One patient had a history of aneurysm of the femoral artery as a complication of arterial puncture. Four patients had a pre-existing pulmonary pathology (previous history of tuberculosis, cortico-dependent asthma, two chronic respiratory failures). The main clinical characteristics are summarised in Table 1.

2.2. Cardiological lesion check-up

All patients underwent a myocardial exercise test, stress thallium testing and cardiac catheterization. Coronarography with left ventricular angiography was performed two months prior to the open heart surgery. Ejection fraction of the left ventricle was between 40 and 65% (mean 51.7 ± 7.4%). One patient underwent mitral surgery under cardiopulmonary bypass (CPB) 12 years before.

2.3. Carotid lesion check-up

- Carotid duplex scanning using pulsed-wave Doppler (7.5 Mhz probe) did not provide any anomaly of the subclavian and vertebral arteries. The common carotid arteries, ICA, and external carotid arteries were imaged and spectral analysis, systolic and diastolic frequency, and velocity data recorded from proximal and distal sites in each artery as well as at the specific sites of any stenosis. Carotid arteries were categorized into one of six degrees of percentage of diameter reduction stenosis (0, 1–16%, 17–49%, 50–79%, 80–99%, occlusion). Critical stenosis was considered to be present if 85% or greater luminal narrowing was detected. Major lesions involved the right ICA in eight patients, with three cases of contralateral ICA occlusion. Two patients had pre-occlusive stenosis of the left ICA, one of them had a contralateral carotid occlusion. In all cases, study of the circle of Willis revealed, through compressive tests, functional substitutes.

- A computerized tomographic scanning of the head confirmed freedom from silent ischemic event.

- Ambulatory digital angiography via the femoral artery included a study of the neck vessels and of the global cerebrovascular system, ‘cerebral bundle’ and a selective four-vessel angiography. The intra-arterial digital subtraction angiography of the extra-cranial arteries allowed measurements of the distal ICA used as diameter reference; the diameter of the ICA on each side was measured at the origin, the level of the first cervical vertebra (C1) and the siphon. The residual lumen size was also measured at any other site of the ICA where there was a visible stenosis. Measurements were made on both lateral and anteroposterior projections and the mean value was taken as a lumen diameter at that site. The percent stenosis for each patient was calculated from the lumen diameter at the site of the stenosis and the greater of the two diameters recorded at C1. For patients with multiple

<table>
<thead>
<tr>
<th>Findings</th>
<th>Number of patients</th>
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<tbody>
<tr>
<td>Cardiac</td>
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<tr>
<td>NYHA II</td>
<td>8</td>
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<tr>
<td>NYHA III</td>
<td>2</td>
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<td>ATCD MI</td>
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<tr>
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<td>EF &gt;50%</td>
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<tr>
<td>Age &gt;65 years</td>
<td>8</td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
</tr>
<tr>
<td>Carotid</td>
<td></td>
</tr>
<tr>
<td>Right carotid</td>
<td>8</td>
</tr>
<tr>
<td>Contralateral thrombosis</td>
<td>4</td>
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n = 10. Mean age = 71 ± 4.3 years.

* MI, myocardial infarction.

b EF, ejection fraction.
carotid lesions in tandem, the severest lesion was used for analysis. All measurements were corrected for magnification.

Cerebrovascular parenchymography with computerized tomogram evaluated the delay in the arterial hemispheric filling or the stasis on the late phase compared to the opposite side, hypo or hypervascularization of the cortical or posterior cerebral area, unilateral stasis to venous time, blood circulation velocity. Angiogram of asymptomatic patients presenting: ICA stenosis, arterial delay, cortical hypovascularization, posterior cerebral vasodilatation and stasis to venous time without modification at the acetazolamide test or on cerebral blood flow mapped by xenon computed tomography were considered as a high-risk group of stroke during CPB.

Three 90% stenoses of the right ICA were evaluated by angiography, two of them with a 60% stenosis of the homolateral carotid root. Five 95% stenoses of the right ICA were assessed with a 50% stenosis of the homolateral carotid root. Three of them were associated with an occlusion of the left ICA. Both stenoses of the left ICA were respectively assessed at 90 and 95%. No patient showed any ulcerated lesions.

2.4. Preoperative TCA

All patients received platelet modifying treatment; preferably Ticlopidine instead of aspirin at doses of 500 mg per day, eight days prior to the procedure. We used the Theron et al. [12] technique with a triple coaxial catheter (Cordis, USA). It proceeded as follows: a 100 cm long 8-French guiding catheter (2.1 mm inner diameter) was positioned in the common carotid artery via a femoral access under local anaesthesia. The occlusive and angioplasty catheters were introduced into the guiding catheter and the latex balloon was positioned at the level of the stenosis. Prior to inflating the occlusive latex balloon (Nicomed, Paris) 7000 to 10 000 units of heparin were administered. After inflation, a clinical tolerance test was performed with deflation of the balloon at the slightest neurological sign. In most cases neurological tolerance improved after 3 inflations, allowing safe TCA. After occlusion, the angioplasty balloon (Medi-Tech, Watertown, MA) (6 mm in diameter, 2 cm in length) was inflated while carefully watching the guiding catheter position during inflation (the guiding catheter needs to be at the inferior edge of the inflated balloon to prevent inferior and superior displacement upon inflation). Prior to inflating the balloon, atropine was injected intravenously immediately before balloon inflation when the stenosis involve carotid bifurcation so as to reduce the bradycardia caused by compression of the glomus. After 2 or 3 inflations, the TCA balloon was deflated and the catheter was removed to the femoral introductor while keeping the protection balloon inflated. A careful wash-suction of the atherosclerosis particles dislodged and clots was performed with 20 ml syringe (cytological examination) over the lateral lines of the guiding catheter, followed by injections of a saline serum under pressure in order to evacuate potential residual fragments towards the external carotid artery. Then the latex occlusive balloon was deflated and an angiographic series was performed. In four cases, the morphological result was unsatisfactory and a larger TCA balloon (7 mm) was set again into the Teflon catheter and a new dilatation was performed (Figs. 1 and 2). During 1993, four TCA were performed, but the necessity to complete one of these dilatations with a Strecker stent (Fig. 3) (Medi-Tech, Watertown, MA), led us to systematically perform this procedure in the other 6 patients (Figs. 4 and 5) in order to reduce the risk of restenosis. The stent was placed straddling the carotid root and ICA thus revascularising the external carotid through the endoprosthesis mesh. After the TCA, the

![Fig. 1. 95% stenosis of the ICA.](image1)

![Fig. 2. Immediate angiography after dilatation with a 7 mm balloon.](image2)
duced into the other femoral artery and positioned partly in the common artery and partly in the origin of the external carotid artery. The complete triple coaxial system was similarly positioned in part in the common carotid artery and in part in the ICA. Inflation of the two angioplasty balloons allowed, in their inferior portions located in the common carotid artery, a ‘kissing’ balloon dilatation. A cerebral parenchymography was always performed immediately after the angioplasty. All the TCA were performed by the same operator (J. Theron).

2.5. Cardiovascular surgical technique

The ten patients with TCA underwent coronary surgery in a mean time of 17.4 days (14–17 days). Ticlopidine–heparin relay by subcutaneous access was set up seven days prior to cardiac surgery. Perfusion flow rates during CBP were maintained between 1.5 and 2.2 l/min/m² and perfusion pressure between 40 and 70 mmHg. All patients benefited from exclusive arterial grafts: three patients had a left internal thoracic artery (ITA) with sequential anastomoses (two double and one triple), six patients underwent bilateral ITA grafts and one patient had three arterial grafts (bilateral ITA and epigastric grafts). The total number of grafts was 27, meaning 2.7 grafts per patient (2–4 grafts). Among patients with bilateral ITA grafts, one of them underwent left ventricular aneurysmectomy and another one an aortic valve replacement. All patients were included in an aprotinin protocol including a dose of one million units of Inhibition-Kallicreine (UIK) at induction, followed by 250 000 UIK per hour until sternal closure, with one million UIK more in the CBP priming. This protocol, instituted in 1992, has reduced peri- and postoperative bleeding during CABG. Mean CPB time was 71.4 min (40–135 min), mean aortic cross-clamping time was 54.8 min (35–90 min).