

Concomitant Brachiocephalic and Coronary Artery Disease: Outcome and Decision Analysis

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Background. In patients with coronary artery disease, concomitant brachiocephalic disease may affect outcome and influence decision making regarding operative staging, technique, and choice of conduit.

Methods. Eighty consecutive patients (mean age, 59.3 years; 60.0% male) with concomitant brachiocephalic and coronary artery disease were identified either before (group A, $n = 48$) or after (group B, $n = 32$) coronary artery bypass grafting. Patients who had symptomatic brachiocephalic and coronary artery disease before surgery underwent concomitant brachiocephalic reconstruction and coronary artery bypass grafting using either all-vein coronary conduits ($n = 41$) or vein-and-internal mammary artery conduits ($n = 7$). Patients who had coronary-subclavian steal syndrome after coronary artery bypass (group B, $n = 32$) underwent either surgical ($n = 5$) or endovascular ($n = 27$) brachiocephalic reconstruction only.

Results. All patients were asymptomatic after intervention. Operative mortality was 4.2% for group A and 3.1% for group B. The perioperative stroke rate was 2.1% for group A and 0% for group B. Actuarial 10-year freedom from specific events for group A was as follows: death

$59.9 \pm 12.8\%$, brachiocephalic restenosis 100%, coronary-subclavian steal syndrome 100%, myocardial infarction $83.5 \pm 10.5\%$, stroke $82.1 \pm 9.9\%$, redo coronary artery bypass grafting $95.8 \pm 4.1\%$, other vascular operation $82.2 \pm 8.9\%$, and adverse cardiac outcome (death, redo coronary artery bypass grafting, or myocardial infarction) $52.9\% \pm 13.2\%$ (for patients with all-vein conduits) or 100% (for patients with vein-and-internal mammary artery conduits). At midterm follow-up (mean, 2.92 years), both the surgical and the endovascular treatment subgroups of group B had 100% brachiocephalic patency.

Conclusions. Long-term results in a limited population support continued evaluation of concomitant brachiocephalic reconstruction and coronary artery bypass grafting with use of the internal mammary artery conduit in an attempt to improve late survival in patients with concomitant disease. The excellent midterm brachiocephalic patency after either surgical or endovascular treatment of patients with coronary-subclavian steal syndrome supports continued evaluation of both methods.

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The presence of concomitant brachiocephalic disease (BCD) and coronary artery disease (CAD) may affect outcome and influence decision-making regarding operative staging, approach, technique, and choice of conduit. Several issues related to the management of patients with concomitant BCD and CAD remain unsettled. In patients with CAD in whom BCD is recognized before coronary artery bypass grafting (CABG) is performed, these issues include the safety of concomitant brachiocephalic (BC) reconstruction and CABG, the durability of BC reconstruction, and the influence of approach, technique, and conduit choice on operative and long-term outcome. Furthermore, there is a lack of consensus re-

garding the optimal management of coronary-subclavian steal syndrome (CSS) in patients in whom concomitant BCD is recognized after CABG. For these reasons, we examined the outcomes of different treatment approaches in both types of patients.

Patients and Methods

We reviewed the hospital records and postoperative clinical charts of 80 consecutive patients (mean age, 59.3 years; 60.0% male) with concomitant BCD and CAD who were treated at our institution between January, 1972 and June, 2004. Supplemental information was obtained from each patient's private cardiologist and family as needed.

Preoperative risk factors were assessed in all patients (Table 1). These included hypertension, diabetes, tobacco use, known CAD, previous myocardial infarction (MI), hyperlipidemia, chronic obstructive pulmonary disorder, and known peripheral vascular disease involving the

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Table 1. Demographic, Clinical, and Operative Characteristics

Characteristic	Group A (n = 48)	Group B (n = 32)	Total (n = 80)
Male (%)	29 (60.4)	19 (59.4)	48 (60.0)
Female (%)	19 (39.6)	13 (40.6)	32 (40.0)
Mean age, y	55.4	65.2	59.3
Age range, y	40-73	59-80	40-80
Risk factors			
Hypertension (%)	27 (56.3)	14 (43.8)	41 (51.3)
Diabetes (%)	8 (16.7)	3 (9.4)	11 (13.8)
Known PVOD (%)	33 (68.8)	17 (53.1)	50 (62.5)
Tobacco use (%)	28 (58.4)	21 (65.6)	49 (61.3)
Previous MI (%)	17 (35.4)	11 (34.4)	28 (35.0)
Known CAD (%)	45 (93.8)	32 (100.0)	77 (96.3)
Hyperlipidemia (%)	7 (14.6)	4 (12.5)	11 (13.8)
COPD (%)	5 (10.8)	9 (28.1)	14 (17.5)
Angina (CCS class) ^a			
II (%)	22 (45.8)	—	22 (27.5)
III (%)	18 (37.5)	—	18 (22.5)
IV (%)	8 (16.7)	—	8 (10.0)
Operative priority			
Elective (%)	40 (83.3)	30 (93.8)	70 (87.5)
Urgent (%)	7 (14.6)	1 (3.1)	8 (10.0)
Emergent (%)	1 (2.1)	1 (3.1)	2 (2.5)
Redo CABG (%)	4 (8.3)	—	4 (5.0)
IABP (%)	3 (6.3)	—	3 (3.8)
Left main (%)	14 (29.2)	—	14 (17.5)
EF <45% (%)	9 (18.8)	—	9 (11.3)
Failed PTA (%)	1 (2.1)	—	1 (1.3)
LIMA (%)	7 (14.6)	—	7 (8.8)
Isolated BCR (%)	—	32 (100.0)	32 (40.0)
CABG + BCR (%)	48 (100.0)	—	48 (60.0)

^a Not related to coronary-subclavian steal.

Group A, concomitant BCD and CAD diagnosed prior to CABG surgery; group B, concomitant BCD and CAD diagnosed after CABG surgery.

BCR = brachiocephalic reconstruction; CABG = coronary artery bypass grafting; CAD = coronary artery disease; CCS = Canadian Cardiovascular Society; COPD = chronic obstructive pulmonary disease; EF = ejection fraction; IABP = intraaortic balloon counterpulsation; Left main = native left main coronary artery disease; LIMA = left internal mammary artery to anterior coronary artery bypass; MI = myocardial infarction; PTA = percutaneous transluminal angioplasty; PVOD = peripheral vascular occlusive disease.

cerebrovascular (carotid), abdominal aortic, or lower extremity vascular distribution.

All patients in this study were admitted to the hospital because of cardiac symptoms; their BCD was diagnosed incidentally (Table 2). In 48 patients (group A), concomitant BCD and CAD was diagnosed before surgery. These patients had evidence of coronary insufficiency (n = 48, 100%) and at least one of the following manifestations of BCD: cerebrovascular insufficiency, upper extremity vascular insufficiency, or upper extremity emboli. According to the reporting guidelines of the Society for Vascular Surgery, each patient in group A had either one or two of three subtypes of cerebrovascular insufficiency: isolated

carotid ocular symptoms, carotid cortical symptoms, and vertebrobasilar symptoms (Table 2, Fig 1) [1]. Patients with upper extremity vascular insufficiency had extremity claudication, fatigue, or sensation of coolness. The only patient with upper extremity emboli had extremity microembolization.

Concomitant BCD and CAD were diagnosed in 32 patients (group B) who had symptomatic coronary ischemia (ie, angina or congestive heart failure [CHF]) after CABG (Table 2). These patients were found to have CSS; ie, myocardial ischemia caused by proximal subclavian artery (SCA) disease that produces reversal of flow in a previously constructed ipsilateral internal mammary artery (IMA) coronary conduit.

Myocardial perfusion was assessed and the presence of ischemia was documented in patients with stable angina by exercise electrocardiography, thallium stress testing, or dipyridamole infusion imaging. Symptoms of ischemia in the upper extremities and hemodynamic changes were reproduced in patients with a stable cardiac status using the method described by Grosveld and colleagues [2]. Ultrasonic duplex scanning with hemodynamic measurements before and after exercise differentiated hemodynamically significant and non-significant lesions.

All patients underwent full invasive radiologic evaluation, including cineangiography of the coronary vessels and arch aortography with runoff views of the carotid, subclavian, and vertebral circulations. Vessel stenosis was determined angiographically by the following formula: $(1 - [\text{diameter at point of greatest stenosis} / \text{diameter at point of greatest patency}]) \times 100\%$. Signifi-

Table 2. Symptoms of Brachiocephalic Lesions at Initial Presentation^a

Symptom Type	Group A (n = 48)	Group B (n = 32)	Total (n = 80)
Cerebrovascular ^b			
A = carotid ocular (%)	1 (2.1)	0 (0)	1 (1.3)
B = carotid cortical (%)	12 (25.0)	0 (0)	12 (15.0)
C = vertebrobasilar (%)	11 (22.9)	0 (0)	11 (13.8)
A + B (%)	1 (2.1)	0 (0)	1 (1.3)
A + C (%)	6 (12.5)	0 (0)	6 (7.5)
B + C (%)	5 (10.4)	0 (0)	5 (6.3)
Total (%)	36 (75.0)	0 (0)	36 (45.0)
Upper extremity			
Claudication (%)	16 (33.3)	0 (0)	16 (20.0)
Microembolization (%)	1 (2.1)	0 (0)	1 (1.3)
Total (%)	17 (35.4)	0 (0)	17 (21.3)
Coronary ^c			
Angina (%)	0 (0)	30 (93.8)	30 (37.5)
Congestive heart failure (%)	0 (0)	2 (6.2)	2 (2.5)
Total (%)	0 (0)	32 (100.0)	32 (40.0)

^a Symptoms classified by vascular territory. Some patients had multiple symptoms. ^b Cerebral hemispheric symptoms are classified using the CHAT system.¹ ^c Caused by coronary-subclavian steal.

Group A, concomitant BCD and CAD diagnosed prior to CABG surgery; group B, concomitant BCD and CAD diagnosed after CABG surgery.

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