Occluding clamp technique during coronary artery bypass grafting: single or double-clamp technique?

Riccardo Sinatra, Fabio Capuano, Eugenio Santaniello, Euclide Tonelli, Antonino Roscitano

Department of Cardiac Surgery, "La Sapienza" University, St. Andrea Hospital, Rome, Italy

Key words:
Coronary artery disease; Stroke; Surgery.

Background. **External manipulation of the diseased aorta during cardiac surgery is the most important mechanism leading to the detachment of atherosclerotic debris due, especially, to the use of aortic clamping. The aim of the present study was to determine the best occluding clamp technique to minimize the risk of postoperative cerebrovascular accidents in patients who undergo isolated coronary artery bypass grafting (CABG): single-clamp technique (SCT) or double-clamp technique (DCT)?**

Methods. **Two hundred and eighty-one consecutive patients undergoing isolated CABG in our center between January 2001 and December 2003 were enrolled. SCT was used in 145 cases and DCT was used in 136 cases. Postoperative adverse events were retrospectively compared between these two groups.**

Results. **The aortic cross-clamp times were longer for patients in the SCT group, whereas the mean cardiopulmonary bypass time was shorter in the DCT group. There were no differences between the two groups in terms of postoperative stroke (0.6% SCT vs 0.7% DCT, p = NS) and hospital mortality (1.3% SCT vs 1.4% DCT, p = NS).**

Conclusions. **The results of this study suggest that, among patients who undergo CABG, there are no differences in neurologic outcome between those in whom DCT was used and those in whom SCT was employed.**

(Ital Heart J 2004; 5 (6): 450-452)

Received February 2, 2004; revision received April 24, 2004; accepted May 3, 2004.

Address:

Dr. Fabio Capuano

Via Acaia, 24
00183 Roma
E-mail:
capmd@katamail.com

Introduction

During cardiac surgery for myocardial revascularization, atheromatous embolization and cerebrovascular accidents are the most devastating complications with an incidence that ranges from 1.5 to 5.2%[1,2].

Moderate or severe atheromatous disease of the ascending aorta may be a marker of generalized atherosclerosis and these patients have an increased risk of morbidity and mortality.

External manipulation of the diseased aorta (aortic cannulation and clamping) is the most important mechanism leading to the detachment of atherosclerotic debris[3].

Neurological deficits resulting from intraoperative events are usually noted within the first 24-48 hours of surgery; however, a small proportion of deficits may develop later during hospitalization usually as a result of postoperative hemodynamic instability or atrial fibrillation. Proper management of the problem substantially reduces the morbidity and mortality of this complication.

Among the strategies developed to minimize this problem (off-pump coronary artery bypass grafting [CABG][4], placement of a proximal saphenous vein graft to the internal mammary artery or the innominate artery[5], hypothermic fibrillatory arrest avoiding clamping of the ascending aorta[6,7], complete arterial revascularization with pedicle arterial grafts, arterial cannulation of the axillary artery[8]) we must include the use of a single-clamp technique (SCT) rather than a double-clamp technique (DCT).

The purpose of the present study was to determine, in patients who undergo isolated CABG, which occluding clamp technique is better to reduce the risk of postoperative cerebrovascular accidents in clinical practice: SCT or DCT?

We performed a retrospective comparison of the clinical outcome following isolated CABG in two groups of patients: one group operated by a surgeon who used SCT and the other group operated using DCT.

Methods

Patients. Between January 2001 and December 2003, 281 consecutive patients un-

derwent isolated CABG in our center. Patients with other cardiac disease and with a history of cerebrovascular disease or carotid bruit were excluded.

SCT was used in 145 cases (group 1, mean age 64.5 ± 5.4 years) and DCT was used in 136 cases (group 2, mean age 65.8 ± 4.6 years). All patients had isolated CABG and in all cases, the preoperative, intraoperative and postoperative data were collected during hospitalization.

Definition of cerebrovascular accidents. All patients with postoperative neurological deficits were routinely evaluated by staff neurologists and psychiatrists; a cerebrovascular accident was confirmed at brain computed tomographic scanning (CT) or nuclear magnetic resonance imaging.

Stroke was defined as a new focal neurological deficit lasting > 24 hours with a CT demonstration of a recent cerebral lesion that became evident at the moment of awakening.

A transient ischemic attack was defined as a new neurological deficit that was evident at awakening, lasted < 24 hours and was associated with a normal brain CT.

Operative technique. The operative technique was similar in all patients. After standard anesthesia, a median sternotomy was performed followed by routine aortic and right atrial cannulation. Cardiopulmonary bypass was carried out using membrane oxygenators and moderate systemic hypothermia (28-31°C). Myocardial protection was achieved by antegrade normothermic hyperkalemic blood cardioplegia and topical cooling with cold saline solution.

For patients in the DCT group, all the distal anastomoses were made during total aortic clamp occlusion and the proximal anastomoses were constructed following release of the aortic cross-clamp and after applying a second partially occluding aortic clamp. In the SCT group, the distal and proximal anastomoses were constructed during a single period of aortic occlusion.

No routine epicardial scanning was performed in the operating room. The quality of the aorta was assessed by the surgeon using his fingers.

Statistical analysis. Determination of statistical significance was performed using the χ^2 test and unpaired Student's t-test for continuous variables as appropriate. A p value < 0.05 was considered statistically significant.

Results

Preoperative and intraoperative patient characteristics. A total of 281 patients were included in the cohort. SCT was used in 145 patients (group 1, 51.6%) and DCT was used in 136 patients (group 2, 48.3%).

The preoperative patient characteristics are compared in table I. The two groups were comparable for age, sex, diabetes, hypertension, previous acute myocardial infarction, intra-aortic balloon pump use, and preoperative arrhythmias.

The operative variables are summarized in table II. The operative data showed that the aortic cross-clamp times were longer for patients in group 1 (74.2 ± 13 vs 46.7 ± 15 min), whereas the mean cardiopulmonary bypass time was shorter in group 2 (71 ± 15 vs 95.5 ± 32 min). The number of bypass grafts and the use of the internal mammary artery did not significantly differ between the two groups.

In 246 (87.5%) patients, the left internal mammary artery was used for the left anterior descending artery and saphenous veins for the other target vessels. In 35 (12.4%) patients, saphenous veins were used for all target vessels.

Postoperative outcomes. There were no differences between groups in terms of cerebrovascular accidents (Table III). Stroke occurred in 1 patient in group 1 (0.6%, 68 years old) and in 1 patient in group 2 (0.7%, 63 years old).

Table I. Preoperative patient characteristics.

	Group 1 (n=145)	Group 2 (n=136)	p
Age (years)	64.5 ± 5.4	65.8 ± 4.6	NS
Female gender	46 (31.7%)	43 (31.6%)	NS
History of diabetes mellitus	33 (22.7%)	38 (27.9%)	NS
History of hypertension	69 (47.5%)	62 (45.5%)	NS
Previous AMI	51 (35.1%)	54 (39.7%)	NS
IABP use	13 (8.9%)	10 (7.3%)	NS
Preoperative arrhythmia	23 (15.8%)	27 (19.8%)	NS

AMI = acute myocardial infarction; IABP = intra-aortic balloon pumping.

Table II. Intraoperative variables.

	Group 1 (n=145)	Group 2 (n=136)	p
Mean CPB time (min)	95.5 ± 32	71 ± 15	< 0.05
Mean aortic cross-clamp time (min)	74.2 ± 13	46.7 ± 15	< 0.05
≥ 3 bypasses	112 (77.2%)	106 (77.9%)	NS
Left internal mammary artery graft	121 (83.4%)	125 (91.9%)	NS
Emergency cases	57 (39.3%)	49 (36%)	NS
Two-vessel disease	45 (31%)	39 (28.6%)	NS
Three-vessel disease	100 (68.9%)	97 (71.3%)	NS
Proximal anastomosis			
1	69 (47.5%)	50 (36.7%)	NS
2	76 (52.4%)	86 (63.2%)	NS

CPB = cardiopulmonary bypass.

Table III. Postoperative outcomes.

	Group 1 (n=145)	Group 2 (n=136)	p
Stroke	1 (0.6%)	1 (0.7%)	NS
Transient ischemic attack	17 (11.7%)	22 (16.1%)	NS
Death	2 (1.3%)	2 (1.4%)	NS
Other complications	11 (7.5%)	18 (13.2%)	NS

A transient ischemic attack was observed in 17 patients in group 1 (11.7%) and in 22 patients in group 2 (16.1%). None of the patients with stroke were diabetics.

Discussion

One of the most devastating complications of CABG is the development of cerebrovascular accidents[9]. Aortic manipulation is a very strong risk factor for an adverse neurological outcome, in particular for stroke[10].

Mills and Everson[11] described a high incidence of stroke after cannulation and clamping of a severe atherosclerotic ascending aorta.

On the basis of these findings, we believe that the main problem is to identify, pre- and intraoperatively, a diseased and risky ascending aorta. Different techniques, such as off-pump CABG and complete arterial revascularization with pedicle arterial grafts, have been proposed to reduce the risk of atheroembolism in patients with a diseased ascending aorta; however, we believe that the avoidance of cardiopulmonary bypass alone (*per se*) does not confer any significant clinical advantage in reducing the risk of stroke. The real goal is not to touch the aorta, and this may be achieved by various techniques.

So adapting surgery to the individual patient is probably the best way to improve outcome.

In this study, our purpose was to determine, in patients who undergo isolated on-pump CABG, which occluding technique decreases the risk of postoperative cerebrovascular accidents in clinical practice: SCT or DCT?

We performed a retrospective comparison of clinical outcomes following isolated CABG in two groups of patients: one group operated by a surgeon who used SCT and the other group operated by another surgeon who used DCT. The preoperative patient characteristics were similar in both groups. The intraoperative variables showed, as expected, that the cross-clamp time for patients in the SCT group (74.2 ± 13 min) was longer that in the DCT group (46.7 ± 15 min). The cardiopulmonary bypass time was also significantly longer in the SCT group (95.5 ± 32 vs 71 ± 15 min, p = NS).

There were no differences between groups in terms of cerebrovascular accidents. Stroke occurred in 1 patient in group 1 (0.6%) and in 1 patient in group 2 (0.7%).

In conclusion, we believe that among patients who undergo CABG there are no differences in neurologic outcome between those submitted to DCT and those submitted to SCT.

References

1. Breuer AC, Furlan AJ, Hanson MR, et al. Central nervous system complications of coronary artery bypass graft surgery: prospective analysis of 421 patients. Stroke 1983; 14: 682-7.
2. Junod FL, Harlan BJ, Payne J, et al. Preoperative risk assessment in cardiac surgery: comparison of predicted and observed results. Ann Thorac Surg 1987; 43: 59-64.
3. Blauth CI. Macroemboly and microemboly during cardiopulmonary bypass. Ann Thorac Surg 1995; 59: 1300-3.
4. Bittner HB, Savitt MA. Management of porcelain aorta and calcified great vessel in coronary artery bypass grafting with off-pump and no-touch technology. Ann Thorac Surg 2001; 72: 1378-80.
5. Weinstein G, Killen DA. Innominate artery-coronary artery bypass graft in a patient with calcific aortitis. J Thorac Cardiovasc Surg 1980; 79: 312-3.
6. Akins C. Noncardioplegic myocardial preservation for coronary revascularization. J Thorac Cardiovasc Surg 1984; 88: 174-81.
7. Dietl CA, Madigan NP, Laubach CA, et al. Myocardial revascularization using the "no-touch" technique, with mild systemic hypothermia in patients with a calcified ascending aorta. J Cardiovasc Surg 1995; 36: 39-44.
8. Sabik JF, Lytle BW, McCarthy PM, Cosgrove DM. Axillary artery: an alternative site of arterial cannulation for patients with extensive aortic and peripheral vascular disease. J Thorac Cardiovasc Surg 1995; 109: 885-91.
9. Tsang JC, Morin JF, Tchervenkov CI, et al. Single aortic clamp versus partial occluding clamp technique for cerebral protection during coronary artery bypass: a randomized prospective trial. J Card Surg 2003; 18: 158-63.
10. Calafiore AM, Di Mauro M, Teodori G, et al. Impact of aortic manipulation on incidence of cerebrovascular accidents after surgical myocardial revascularization. Ann Thorac Surg 2002; 73: 1387-93.
11. Mills NL, Everson CT. Atherosclerosis of the ascending aorta and coronary artery bypass: pathology, clinical correlates and operative management. J Thorac Cardiovasc Surg 1991; 102: 546-53.