TRANSIT TIME FLOWMETRY IN CORONARY SURGERY- AN IMPORTANT TOOL IN GRAFT VERIFICATION

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Abstract

The aim of this study was to analyze the Transit time flow measurement (TTFM) experience in the first 1000 CABG operations. First 1000 patients had coronary artery bypass grafting (CABG) performed in Cardiovascular Clinic, University Clinical Centre Tuzla, Bosnia and Herzegovina, between September, 1998 and September, 2003. CABG without use of cardiopulmonary bypass (CPB)-(OPCAB) was used as the preferential surgical method both because this method is reported to have equal or better results than CABG with use of CPB (ONCAB), and because of the significant cost savings realized. TTFM was routinely used in all grafts as a quality assurance measure. Criteria for a poor functioning graft were: low mean flow (MF), pulsatility index (PI) above 5 and a poor diastolic flow pattern. When no reversible cause of poor TTFM results were identified the graft was revised. A total of 1394 grafts in OPCAB group and 1478 in ONCAB group were performed. A total of 38 grafts (2,72%) in 37 patients (7,07%) were revised in OPCAB group, and 26 grafts (1,75%) in 26 patients (5,45%) in ONCAB group. 1 patient in OPCAB group needed 2 graft revisions. Graft revisions were more common in OPCAB, but with no significant difference (p=0,1035). The most frequently revised graft was LAD graft in both groups. Although the percentage of grafts revised are relatively low, it is still very important to record TTFM. More than 5% of patients in both groups needed graft revision. Although TTFM does not guarantee that grafts will stay open for a prolonged period of time we certainly believe that grafts that are occluded at the time of surgery will continue to stay occluded. TTFM is especially critical in OPCAB surgery where the technical challenge of grafting is higher then in ONCAB.

KEY WORDS: coronary artery bypass grafting, Transit time flow measurement

Introduction

Graft patency remains an important issue in coronary surgery (1). Early graft occlusion is a frequent cause of early death and perioperative myocardial infarction. Occluded grafts will also limit the long term value of the operation. An accurate simple method of graft verification is therefore important (2). We have routinely used Transit time flow measurement (TTFM) (Cardiomed Flowmeter, Medistim AS, Oslo, Norway) in all patients after starting our cardiac surgery program. The purpose of this study was to analyze the TTFM experience in the first 1000 coronary artery bypass grafting (CABG) operations performed until September, 2003.

Materials and Methods

First 1000 patients had CABG performed in Cardiovascular Clinic, University Clinical Centre Tuzla, Bosnia and Herzegovina, between September, 1998 and September, 2003. CABG without use of cardiopulmonary bypass (CPB)-(OPCAB) was used as the preferential surgical method both because this method is reported to have equal or better results than CABG with use of CPB (ONCAB) and because of the significant cost savings realized (3). However about 50% of all operations were done as ONCAB since it was necessary to retain perfusionist proficiency. The patients operating room records were examined and in cases where a graft was performed more than once, the graft was counted as revised.

Grafts were revised according to criteria described earlier. In brief this criteria describes a poor functioning graft as a graft with low mean flow (MF), pulsatility index (PI) above 5 and a poor diastolic flow pattern (4). In grafts where borderline values were obtained measurements were repeated after a short time period to allow removal of any air in the grafts. Sometimes papaverine was utilized to relieve any spasm. Also the mean blood pressure was sometimes raised to increase the perfusion pressure. A final assessment of the TTFM results were obtained after administration of protamin and the graft accepted or revised.

In OPCAB surgery it is our routine to utilize proximal coronary snaring during grafting to control blood flow in the native vessel. This snare was left in place until after measurement of TTFM. Flows were measured with and without proximal snare. In this way obstruction at the toe of the anastomosis may be detected, since flow would decrease or stop completely when the snare was applied. When non acceptable TTFM parameters were seen graft revision was performed and any reason for graft obstruction recorded. Measurements were repeated after revision. In most cases the grafts were revised without CPB, but in some cases CPB was utilized due to technical considerations or hemodynamic instability.

In ONCAB surgery we do not use proximal snare during grafting and in general did not find it justified to use snare for measurements since at least theoretically snares may cause vessel damage. The grafts were examined after completion of all bypasses and after discontinuation of CPB. If grafts needed revision, CPB would be reinstituted and the grafts revised with or without cross clamp and cardioplegia, depending on the situation.

Results

A total of 1394 grafts in OPCAB group and 1478 in ONCAB group were performed. A total of 38 grafts (2,72%) in 37 patients (7,07%) were revised in OPCAB group, and 26 grafts (1,75%) in 26 patients (5,45%) in ONCAB group. 1 patient in OPCAB group needed 2 graft revisions. As can be seen graft revisions were more common in OPCAB group but with no significant difference (p=0,1035) (Table 1).

As can be seen the most frequently revised graft in both groups was LAD graft (Table 2). Graft revisions were seldom for RCA and DIAG grafts. There were no significant difference in incidence of revision for same grafts in both groups. In both groups all grafts could be revised successfully and graft patency at the time of chest closure documented.

	OPCAB	ONCAB	p
	N	%	N
Total number of patients	523	100	477
Total number of patients with revised grafts	37	7,07	26
Total number of grafts	1394	100	1478
Total number of revised grafts	38	2,72	26

TABLE 1. Total number of patients with revisions and revised grafts in both groups

Grafts	OPCAB			ONCAB			p
	total	revised	%	total	revised	%	
LAD	523	20	5,16	477	14	2,93	= 0,5484
DIAG	132	1	0,75	115	0	0,00	= 0,9449
CX	366	14	3,82	475	10	2,10	= 0,2019
RCA	373	3	0,80	411	2	0,48	= 0,9133
Total	1394	38	2,72	1478	26	1,75	= 0,1035

LAD-Left anterior descending artery, DIAG-Diagonal artery, CX-Circumflex artery, RCA-Right coronary artery

TABLE 2. Revised grafts in both groups

Discussion

Graft patency is an obvious goal in coronary surgery (5). Early occlusion of grafts is the main cause of perioperative infarction and mortality. Many patients with graft occlusion survive only to develop recurrent angina postoperatively resulting in less than optimal clinical results or re-interventions (6). When interest in OPCAB surgery in the early 1990 started to increase it became obvious to surgeons doing this type of operations that the technical challenge was higher than with ONCAB. In the beginning anastomosis were performed without mechanical stabilization as were done by surgeons from South America who had performed OPCAB surgery for two decades (7). It therefore became a major task to find a practical instrument for graft verification. Based on the experience from Buffalo, USA (8) we used TTFM to verify every graft performed in every patient since the initiation of the cardiac program. The causes of revision were multiple with about 50% of the revisions clearly technique related and the rest more related to vessel factors. Most revision were seen in the graft to LAD whether the operation was done as OPCAB or ONCAB. However the rate of revision was higher in OPCAB operations but with no significant difference. The fact that snare was not utilized in ONCAB may underestimate the graft problems in this group since obstruction at the toe of the graft may be missed when snare is not utilized.

Almost surprisingly graft revision in other territories were much lower than in the LAD area. This may be due to the fact that these other grafts were mainly veins and that the higher problems in LAD was due to the preferential use of LIMA to graft LAD. Arterial grafts are as known technically more difficult. There may be some underreporting of revision in these series since the numbers were counted from the operation room report. In some cases it is possible that the surgeon has omitted recording of graft revisions. Although the percentage of grafts revised are relatively low it is still very important to record TTFM. More than 5% of all patients needed graft revision.

Conclusion

Although TTFM does not guarantee that grafts will stay open for a prolonged period of time, we certainly believe that grafts that are occluded at the time of surgery will continue to stay occluded. TTFM is especially critical in OPCAB surgery where the technical challenge of grafting is higher then in ONCAB. In conclusion it is our opinion that TTFM should be performed in all coronary surgery.

List of Abbreviations

CABG- coronary artery bypass grafting
CPB- cardiopulmonary bypass
CX-Circumflex artery
DIAG-Diagonal artery
LAD-Left anterior descending artery
OPCAB- coronary artery bypass grafting without use of cardiopulmonary bypass
ONCAB- coronary artery bypass grafting with use of cardiopulmonary bypass
RCA-Right coronary artery
TTFM- Transit time flow measurement

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