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Coronary Artery Bypass Grafting with Radial Artery : Early Results

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Abstracts **Coronary artery bypass grafting (CABG) using arterial conduits has gained increasing role in surgical treatment of patients with ischemic heart disease. This study reviews our early results of using radial artery in CABG at our institution.**

Between December 1997 and July 1999, a total of 32 patients underwent CABG at Central Chest Hospital. There were 28 males and 4 females with the average age of 57.9 years. Follow-up ranged from 1 to 19 months with the mean of 11.8 months. Average distal anastomoses in this study was 3.65 (ranged 2-6). Radial artery was used as unilateral (31) and bilateral (1). Bilateral internal mammary artery was used in 19 patients. There was one hospital mortality from problem of low cardiac output. No neurovascular complication of the upper extremity was found. We concluded from our study that radial artery can be used safely with good early result in CABG.

Coronary artery bypass grafting (CABG) using an arterial conduit has gained an increasing role in surgical treatment of patients with ischemic heart disease. This is because of the excellent long-term results of the internal mammary artery as an arterial graft in CABG. Use of the radial artery as an arterial conduit for myocardial revascularization was first done in the early 1970s by Carpentier et al.[1] It was soon abandoned, however, because of the problem of spasm of the artery resulting in a high incidence of early closure of the graft. Current use of calcium antagonists has substantially improved the result of this conduit as reported by Acar et al in 1992.[2] In this study, we would like to review our early results of using radial artery in CABG patients at our institution.

Materials and Methods

Between December 1997 and July 1999, a total of 32 patients underwent CABG using radial artery in combination with other conduits at Central Chest Hospital. Contraindications for the use of radial artery included inadequate collateral flow to the forearm and hand, patients with Raynaud's disease, need for hemodialysis, previous trauma to the forearm or vascular anomaly. Of the patients, there were 28 males and 4 females. Their ages ranged from 39 to 72 years, with a mean of 57.9 years. Follow up ranged from one to 19 months, with an average of 11.8 months. Coronary angiographic study revealed six of the patients had left main coronary stenosis. Twenty-nine patients had

triple vessel disease and 3 had double vessel disease. Preoperatively, according to the Canadian Cardiovascular Society Functional Classification of Angina Pectoris (CCS), 15 of the patients were CCS class II, 15 were CCS class III and the other 2 were CCS class IV. The average ejection fraction (EF) of the patients was 58.5 per cent, and the average left ventricular end diastolic pressure (LVEDP) was 23.2 mmHg. Allen's test was determined in every candidate to ensure the adequacy of collateral flow from the ulnar artery. All of the patients were followed at the CABG clinic postoperatively by the same group of surgeons. Follow-up was complete in every patient.

Surgical techniques

A median sternotomy was performed in all patients and cardiopulmonary bypass was instituted. Simultaneously, the radial artery was harvested by another surgeon using the technique as described by Reyes et al.[3] Usually the left hand artery was taken for right-handed patients. The lateral cutaneous nerve was always identified and preserved. The side branches were clipped and cut carefully. The artery was left in place after flushing with papaverine solution. It was cut just before use for distal anastomosis in CABG. Other conduits were harvested accordingly. Myocardial protection was achieved by using moderate hypothermia (28-30°C) and combined antegrade and retrograde cold blood cardioplegia was given every 25-30 minutes. Warm blood terminal perfusion was given prior to aortic declamping.

Pharmacologic regimen

A calcium channel blocker was routinely used in order to prevent arterial spasm. Diltiazem (Herbessor, Tanabe, Osaka, Japan.) was given intravenously as a bolus dose of 0.1-0.2 mg/kg and maintained at the dose of 0.2-0.5 microgram/kg/min for the next 24 hours. Oral medication was then continued at the dose of 90-180 mg/day, preferably with the sustained release form, for at least 6 months.

Operations

Isolated CABG was performed in 29 patients. Other associated operations were mitral valve repair[2] and endarterectomy of the left anterior descending artery.[1] A range of 2-6 distal anastomoses were performed on each patient (Table 1). The total numbers of distal anastomoses including both venous and arterial grafts were 117, with an average of 3.65 anstomoses per patient. Total arterial revascularization was successful in 15 of the patients in this study. Bilateral internal mammary arteries (IMA) were used in 19 patients. Of the bilateral IMA group, all of the right IMAs were used as pedicle grafts, while 17 of the left IMAs were used as pedicle grafts, and 2 as free grafts. The radial artery was used in all patients as unilateral (31) and bilateral (1). Two of the radial arteries were used as composite grafts with the right IMA. Distal anastomosis using sequential grafting technique was performed in seven patients, six with radial artery and the other one with saphenous vein graft. The total number of distal anastomoses by arterial and venous conduits were 90 and 27, with an average of 2.81 and 0.8 per patient, respectively. The total number of distal anastomoses using the radial artery was 39, with an average of 1.22 anastomoses per patient. The distribution of distal anastomoses by each conduit is shown in Table 2. The average bypass and aortic clamp times were 153 and 105 minutes, respectively.

Table 1. Coronary Artery Bypass Grafting: Number of distal anastomosis.

CABG	Range 2-6
x2	2
x3	13
x4	12
x5	4
x6	1
Total	**32**

CABG = Coronary Artery Bypass Grafting

Results

There was one hospital mortality due to low cardiac output. This patient died in day 4 postoperatively. No neurovascular complication of the upper extremities was detected in this study, except for a few patients who experienced some feeling of paresthesia at the base of the thumb region. All were completely resolved within two months. Complications included perioperative infarction,[1] low cardiac output requiring intra-aortic balloon counter pulsation (IABP),[1]

Table 2 Distribution of distal anastomosis

		Distribution of distal anastomosis							
		LAD	I	D	OM	RCA	PDA	PL	Other
LIMA		30	-	2	-	-	-	-	-
RIMA		-	-	-	-	13	4	-	LRA = 2
RA	L	1	1	2	25	2	2	3	-
	R	-	-	2	1	-	-	-	-
SVG		-	2	8	8	1	5	3	-

LIMA = Left internal mamary artery
RIMA = Right internal mammary artery
RA = Radial artery
SVG = Saphenous vein graft
LAD = Left anterior descending artery
I = Intermediate branch
D = Diagonal branch
OM = Obtuse marginal branch
PDA = Posterior descending artery
PL = Posterolateral branch

tracheostomy from prolonged intubation[1] and bleeding.[3] All of the surviving patients were in CCS class I, and had substantial improvement of their symptoms and functional status.

Discussion

Current interest in using arterial conduits in CABG stems from the excellent long-term results of the use of the IMA as an arterial graft. Attempts to use the radial artery were first tried in the early 1970s by Carpentier et al. It was soon realized, however, that the artery had a high tendency of spasm and resulted in early closure of the graft. Use of a calcium channel blocker as well as improvement of the harvesting technique had substantially improved the result of this graft as reported by Acar et al in 1992. Since then, this artery has steadily gained more popularity as another alternative arterial conduit in CABG. Use of the radial artery in this study allowed us to achieve more arterial grafting to distal targets which were mainly the obtuse marginal branches in this study (Table 2). This area would otherwise be more difficult to reach by IMA graft. We also found that the use of composite grafts and sequential grafting techniques were very useful for this purpose, allowing the radial artery to graft to more distal targets (average distal anastomosis by radial artery was 1.22 per patient). Combined use of these techniques, along with bilateral IMAs produced a success rate of total arterial revascularization of about 50 per cent in this study. Also, the average number of distal anastomoses by arterial graft per patient was much higher than those of venous grafts (2.81: 0.8). Theoretically, this should be beneficial for the patients in terms of a better patency rate of the graft.

The safety of the use of this conduit is of particular concern. Several methods of assessment have been advocated by many studies,[4,5,6,7,8] i.e., Allen's test, angiographic study, dynamic Doppler test, and oximetric plethysmography, to ensure the adequacy of the collateral supply from the ulnar artery. We found that the use of preoperative Allen's test is a simple, reliable and practical evaluation for this purpose. If the result of the test is doubtful, i.e., rapid return of capillary circulation to the radial side of the ischemic hand does not occur within 10 seconds, the conduit is not used. Finally, good back flow from the ulnar artery must be seen from the cut end of the radial artery before the conduit is completely transected for use as a graft. Use of this approach has proven to be safe for our patients. To prevent the problem of arterial spasm, we routinely give parenteral Diltiazem during both preoperative and postoperative periods. The dosage has been adjusted, however, from that recommended by Menasse et al[5] to avoid problems of bradycardia and hypotension that may occur with the use of this drug. We found the dosage and regimen of the drug, as mentioned above, is effective and safe in our patients. The combined use of the pharmacologic regimen along with proper harvesting technique, (i.e., minimal touch and avoidance of skeletinization of the conduit), is believed to be important to prevent this critical problem. Use of the radial artery also increased the success rate of total arterial revascularization,

another interesting trend in CABG in this study. It is therefore a very attractive arterial conduit for CABG.

In conclusion, use of the radial artery for CABG is safe, and offers good early results in our patients. Proper use of the pharmacologic regimen and proper surgical technique is important to prevent arterial spasm. The radial artery should be considered as a safe and useful alternative arterial conduit in CABG. Its use should be encouraged in order to increase the rate of arterial revascularization. Long-term follow up is mandatory.

References

1. Carpentier A, Guermonprez JL, Deloche A, Frechette C, Dubost C. The aorta - to - coronary radial artery bypass graft. Ann Thorac. Surg 1973; 16: 111-21.
2. Acar C, Jebara V, Portoghese M, Beyssen B, Pagny J, Grare P, Chachques J. Revival of the radial artery for coronary artery bypass grafting. Ann Thorac Surg 1992; 54: 652-60.
3. Reyes A, Frame R, Brodman R. Techniques for harvasting the radial artery as acoronary artery bypass graft. Ann Thorac Surg 1995; 59: 118-26.
4. Calafiore A, Giammarco G, TeodoriG, D'Annunzio E,Vitolla G, Fino C,Maddestra N. Radial artery and inferior epigastric artery in composite grafts: improved midterm angiographic results. Ann Thorac Surg 1995; 60: 517-24.
5. Menasse E, Sperti G, Suma H, Canosa C, Kol A, Martinelli L, Schiavello R, Crea F, Masori A, Possati GF. Use of radial artery for myocardial revascularization. Ann Thorac Surg 1996; 62: 1076-83.
6. Dietl C, Benoit C. Radial artery graft for coronary revascularization : technical consideration. Ann Thorac Surg 1995; 60: 102-10.
7. Dacosta F, Dacosta I, Poffo R, Abuchaim D, Gaspar R, Garcia L, Faraco D. Myocardial revascularization with the radial artery : a clinical and angiographic study. Ann Thorac Surg 1996; 62: 475-80.
8. Brodman R, Frame R, Chamachom, Hue, Chen A, Hollinger I. Routine use of unilateral and bilateral radial arteries for coronary artery bypass graft surgery. J Am Coll Cardiol 1996; 28: 959-63.