

The Radial Artery in Coronary Surgery – Our Initial Clinical Experience

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Objective: We compared in our experience the radial artery harvested in the skeletonized versus pedicled manner as an additional arterial graft for coronary surgery.

Material and methods: In this study we evaluated the results obtained of 47 patients to whom we harvested the radial artery using skeletonized technique (14 cases) and pedicled technique (33 cases). In all the cases, preoperatively the radial artery was evaluated by using the modified Allen test, echo Duplex and angio CT, intraoperative the grafts were used for grafting the circumflex and right coronary system grafting and postoperative the patients were evaluated clinically and angiographically.

Results: The age was situated in between 36–77 years. The harvest time was comparable for both methods (mean 42 minutes vs 34 minutes), the length of the conduit was also comparable (mean 14.4 cm vs 13.9 cm) and without having local complication in both techniques, but the diameter of the graft and its uniformity was greater with the “pedicled” method (mean 3 mm vs 2.2 mm). The function of the grafts was good in both circumflex and right coronary systems, with corresponding values measured at the end of the operation: flow 21–67 ml/min (mean) and pulsatility index 1.3–3.9 (mean). There were no complications at the harvest site and the patients were free from angina after the operation, the angiographic control demonstrating a good function of the grafts in both groups.

Conclusions: The “pedicled” surgical harvest of the radial artery offers an arterial graft with a superior and uniform diameter associated with a corresponding length for the patients with total arterial myocardial revascularization.

Keywords: radial artery, total arterial myocardial revascularization, CABG

Introduction

The radial artery (RA) was introduced as a coronary bypass graft more than 40 years ago by Carpentier and colleagues in 1971, but soon abandoned because of poor immediate results revealed by postoperative coronary angiography [1]. Radial artery being a muscular limb artery of functional classification type III is prone to spasm and this was thought to contribute to the poor immediate results [2]. After the first disappointing experience, in 1992 Acar and colleagues [3] stimulated renewed interest in the use of the radial artery (RA) in coronary artery bypass grafting (CABG). Since then, many groups have reported encouraging short-term and midterm clinical and angiographic results with this conduit [4–7]. In recent years the tendency in total arterial myocardial revascularization, is to use the radial artery graft as an alternative besides the two internal mammary arteries.

The aim of this study is to compare, in our experience, the radial artery harvested in the skeletonized versus pedicled manner as an additional arterial graft for coronary surgery.

Material and method

In this study we evaluated the results obtained of 47 patients (45 males and 2 females) to whom we harvested the radial artery using skeletonized technique (the first 14 cases) and pedicled technique (33 cases). In all the cases, preoperative it was evaluated the status of the collateral circulation of the hand (in order to be able to quantify the possibility

of appearance of the ischemia at this level) by noninvasive methods of investigation of the radial / ulnar vascular wall and the blood flow at this level (the modified Allen test, Doppler echography) and radial artery morphology using angio-CT investigation.

Modified Allen's test consist of the compression of both radial and ulnar arteries for 30 seconds just above the wrist, during which time the hand was rendered ischemic by clenching and slow relaxation; this procedure was repeated three times. The ulnar artery was released and a hyperemic response in the hand extending to the thenar eminence and thumb within 5–15 seconds indicated satisfactory ulnar collaterals and nondominance of the radial artery, and that it could be safely used without potential hand ischemia.

By Doppler echography morphologic and functional characteristics of forearm and hand circulation were assessed. The inner diameter of RA, diffuse calcifications, and anatomic abnormalities of the forearm vessels were the morphologic properties that were recorded.

Angio CT investigation was performed to ensure suitable radial artery morphology, but only few patients were examined using this method due to its high cost.

Techniques of Radial Artery Harvesting

Radial artery harvesting was avoided in patients with renal dysfunction (serum creatinine >1.8 mg/dl) or patients with a positive Allen test. The radial artery was primarily harvested from the non-dominant arm (in all cases the left one).

Table I. Distribution of patients by gender

Gender	Number of patients
Male	45
Female	2

Table II. Harvesting time for the two techniques

Technique	Time (min)
Pedicled technique	34
Skeletonization technique	42

Table III. Graft diameter

Technique	Diameter (mm)
Pedicled technique	3
Skeletonization technique	2.2

Both harvest techniques was performed in a “no touch” manner with “vessel loop”. All side branches were clipped with titanium clips. The vessel was prepared, beginning from the wrist (transection limit proximal from the anterior carpal branch of radial artery) until the bifurcation of the brachial artery (transection limit distal from the recurrent radial branch of radial artery). For harvesting as a pedicled graft, the RA was taken with adjacent veins and covering fascia was mobilized beginning from the middle of the vessel (Fig. 1). Special care was addressed in order to avoid lesions to the sensitive nerves which are situated nearby: the lateral antebrachial cutaneous nerve and the superficial branch of the radial nerve.

Intraoperative the grafts were used for grafting the left anterior, circumflex and right coronary system grafting and postoperative the patients were evaluated clinically and angiographically.

CABG (Coronary artery bypass grafting)

After harvesting of the appropriate grafts CABG was performed under cardio-pulmonary bypass (45 cases) or un-

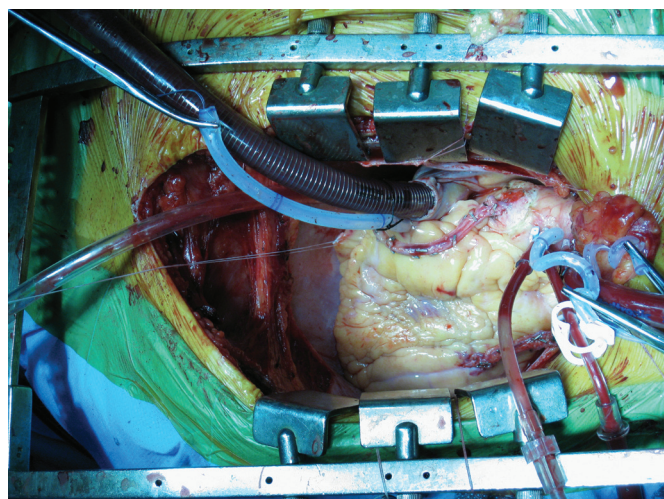


Fig. 2. Radial Artery (implanted on RCA) and Internal Thoracic Artery (implanted on LAD)



Fig. 1. Harvested Radial Artery

der off-pump beating-heart (2 cases) with normothermia (36°C). The radial artery was used for revascularization of the branches of the left anterior descending artery system (7 cases on left anterior descending artery, 2 cases on diagonal artery), circumflex artery system (8 cases on main trunk, 18 cases on obtuse marginal artery) or in the right coronary artery system (2 cases main trunk, 10 cases right posterior descending artery) (Fig. 2). When arteriosclerosis of the aorta was expected, the radial artery was used as a composite Y graft (2 cases – proximal left internal mammary artery and distal on obtuse marginal artery). The proximal diameter of the radial artery was measured just before the proximal anastomosis.

For the statistical analysis we used Kolmogorov Smirnov normality test and T test for mean comparison, with significance level of 0.05. Data analysis was performed using GraphPad instat 4.0 demo version.

Results

The mean patient age was 57.38 ± 9.64 years (between 36–77 years). The study included 45 males and 2 females.

Harvesting time was comparable for both methods, the mean for the skeletonization technique was 42 minutes and

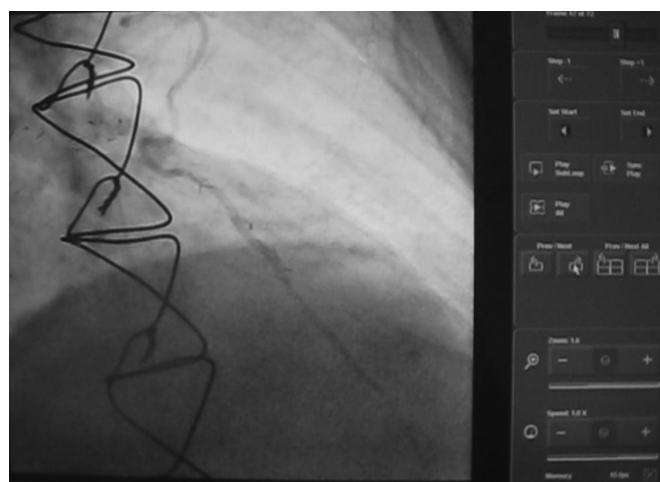


Fig. 3. Radial artery angiographic control

34 minutes for pedicled technique ($p < 0.001$). The length of the conduit in skeletonization technique had a mean of 14.4 cm and 13.9 cm in pedicled technique ($p > 0.05$).

No local complications were observed in either technique. The diameter of the graft and its uniformity was greater with the “pedicled” method with a mean of 3 mm and 2.2 mm in skeletonization technique ($p > 0.05$).

The function of the grafts was good in all coronary systems, with corresponding values measured at the end of the operation: mean flow 15–67 ml/min and mean pulsatility index 1.3–3.9. There were no complications at the harvest site and the patients were free from angina after the operation, the angiographic control demonstrating a good function of the grafts in both groups (Fig. 3).

Discussions

Many publications recommend the use of the radial artery in coronary artery bypass grafting either as skeletonized or as pedicled graft together with its accompanying veins and perivascular tissue. The reasons for promoting the pedicled technique are the vasospastic properties of the vessel [8,9]. Moreover, the pedicle technique is simpler and less time consuming. On other side, the skeletonized technique provides other advantages mainly as a longer graft, the possibility of identify the atherosclerotic plaques or the easier technique of making sequential anastomoses. Our study showed a statistically significant difference between the harvesting times in the two techniques. Another similar study conducted by Rukosujew *et al* in 2004 [10], also showed a statistically significant difference between the harvesting times with a mean of 37.1 ± 3.5 min for skeletonization technique and a mean of 24.4 ± 3.9 min for the pedicled technique. Regarding the graft length our results did not show a significant difference between the two techniques, as other study show (20.8 ± 1.5 cm in skeletonization technique and 19.1 ± 0.9 cm in pedicled technique). The internal thoracic artery (ITA) and the radial artery are both arterial grafts but in between the there are different aspects regarding the thickness of the media wich is thinner in the internal thoracic artery [11], wich gives a higher tendency to spasm to the radial artery. Besides this, the fact that in the majority od cases the ITA is implanted “in situ” (preserving it’s anatomical origin) will provide to this graft a minor tendency to spasm compare with the RA wich is implanted as a “free graft”. Thus all the effort has to be done in order to minimalise the handling and to avoid producing any lesions of the radial artery during harvest. Recent studies shown that indeed RA cand be implanted at any given level of the coronary arteries and the results are good both on the postoperative period but also on long term, if there is respected the principle of high degree of the native vessel stenosis [12] and whith both harvest techniques [13]. Compared with the venous grafts the RA has the advantage of less tendency to dilatation or degeneration in time, thus providing a better outcome

for the patient [14]. The results of our study demonstrates that for the patients with coronary artery bypass grafting the radial artery is an excellent conduit in addition to the internal thoracic artery.

Conclusions

The radial artery represents a good graft for coronary surgery. The skeletonization technique has the benefit of providing a longer graft, but the “pedicled” surgical harvest of the radial artery offers some evident advantages such as an arterial graft with a superior and uniform diameter associated with a corresponding length for the patients with total arterial myocardial revascularization.

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