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EVALUATION OF THE EFFECTIVENESS OF RADIAL ARTERY GRAFT IN CORONARY ARTERY BYPASS GRAFT SURGERY

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ABSTRACT

In order to have a superior graft of coronary artery bypass graft surgery, the study evaluates the early and intermediate results of radial artery grafts in coronary artery bypass graft surgery. 147 patients were faced with coronary artery bypass graft surgery from September 2008 to February 2016, their mean age was 63 ± 10.02 years, men accounted for 74.83%. With 160 radial artery graftings are connected to the bypasses of left coronary artery 87.07% and right coronary artery 12.93%. A total of 81 patients were enrolled in coronary artery by cardiac catheterization and a 64-slice CT scan, the rate of left Internal Thoracic Artery and right Internal Thoracic Artery were 98.77% and 93.75% respectively, the rate of the radial artery was 92.85% and the rate of saphenous vein grafts was 82.5%. There were no cases of premature death within 30 days after surgery. 142 patients were monitored, mean: 55 ± 4.8 months (18 months, 60 months), 9.86% patients had recurrent chest pain. The median recurrence period was 36 months, with 95% confidence intervals from 18 to 36 months. Average follow-up: 48.8 months (18 months, 60 months), 4.76% of patients died. Median survival was 57 months, with 95% confidence interval: 18 - 57 months. Use of radial artery graft in coronary artery bypass graft surgery had good results and rate of articulation. The complication and mortality rate was dependent on the age factor over 70 and the left ventricular ejection fraction below 40%. Taking a radial artery is feasible, safe and effective.

KEYWORDS

Coronary artery bypass graft surgery, Radial artery, Radial artery, Internal thoracic artery and Myocardial infarction.

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INTRODUCTION

Coronary artery bypass graft surgery is one of the most influential surgeries in medical history because this type of surgery can help extend and improve the lives of people with coronary artery diseases. The complication time is an important criteria for evaluating surgical outcomes. This time depends on many factors, in which grafting material is a very important factor. Today, the internal thoracic artery, radial artery and saphenous vein are widely used as graftings^{9, 11}. Use of radial artery for

coronary artery grafting¹ was first introduced by Carpentier in 1971¹³. The radial artery is similar to the length and size of the internal thoracic artery, its diameter is close to the diameter of coronary artery more than saphenous veins, which are easily taken and rarely affected by atherosclerosis. Although the majority of reports relating to the use of radial artery graft in coronary artery bypass graft surgery during the past 10 years suggest that radial artery is a good graft^{8,9,11,12} in Vietnam, there is no specific study on this graft, many questions have not been answered adequately and still controversial. With wishing to have a better graft in coronary artery bypass graft surgery, we conducted the study with the objectives: To evaluate the early and intermediate results of the radial artery graft in the coronary artery bypass graft surgery.

Objects and methodology of research

Objects of research: 147 patients undergoing coronary artery bypass graft surgery at Hospital of University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam and Tam Duc Heart Hospital, Vietnam from September 2008 to February 2016.

Methodology of research: describe longitudinal, prospective cutting. Sample size is calculated according to the following formula:

$$n \geq (1.96/m)^2 p(1-p)$$

Where n is the minimum sample size necessary for the study; m is the allowable tolerance, select $m = 0,05$; p is the smoothness rate of the grafting.

The minimum sample size in the study was 140 graftings.

Criteria for admission

1. Patient is indicated for surgery: narrow or common stem trunk with three narrow coronary arteries
2. The patient agrees to participate in the study.

Exclusion criteria

1. Patients with invisible radial artery or positive Allen method; (2) Patients with abnormal Doppler ultrasonography, or history of angioedema, a history of burger disease or Raynaud's syndrome.

RESULTS

Patients with mean age of 63 ± 10.02 . Men account for 74.83%. Average body mass index (BMI): 23.83 ± 2.78 kg / m². Before surgery, myocardial infarction: 40.1%; Angina pectoris: 90.5%; Arrhythmia: 5.4% (75% with atrial fibrillation or flutter, 25% with left ventricular or ventricular fibrillation); Stroke: 1.4%; Classification of chest pain: 72.8% CCS II, CCS I and III were 12.3%, CCS IV 2.7%; NYHA heart failure rate: 72.5% NYHA II, 16.3% NYHA III. Preoperative assessment of morbidity and mortality. Euro SCORE: average: 2.7 ± 1.6 .

Surgical appointment: 34% subacute myocardial infarction; 28.6% unstable angina/ NSTEMI; 6.8% had general body narrowness, 2% had cardiac arrest, and 0.7% had perforation. Mean duration of aortic stapling was 62.6 ± 15.8 minutes, mean surgery time was 338.4 ± 69.0 minutes, mean circadian rhythm was $114 \pm 36, 5$ minutes. 100% of patients received radial artery grafts, with 160 graftings being performed. In particular, the radial artery connecting with the bypasses of right coronary artery was 128 cases accounting for 87.07% and connected to the bypasses of the right coronary artery was 19 cases accounting for 12.93%.

Complications of the forearm and hand: 12 cases of paresthesia and numbness in the area of the forearm and hand, accounting for 8.16%, in which: 7 cases of abnormal palm sensation, accounting for 4.76%; 5 cases of palpitations, accounting for 3.4%; (2) There are 2 cases of thumb, accounting for 1.36%; Six patients (6.8%) described some atypical symptoms such as discontinuous or cold sensation in the area of the incision. Of these, 12 cases had paresthesias and numbness, and 9 cases (75%) improved after 1 year.

Results of coronary artery bypass graft image: A total of 81 patients were examined for coronary artery by cardiac catheterization and a 64-slice CT scan, The overall rate of joint involvement of left and right thoracic arteries were 98.77% and 93.75%, respectively, the radial artery was 92.85% and the one of saphenous vein graft was 82.5%. The ratio of postoperative complications in people aged

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70 years or older was 47.8%, with a higher rate of complications than patients under 70, $p = 0.002 < 0.05$. The complication rate in patients with $EF \leq 40\%$ was 60%, nearly double that of patients with $EF > 40\%$, the difference was statistically significant at $p < 0.05$. There were no cases of premature death within 30 days after surgery. 142 patients were monitored, mean: 55 ± 4.8 months (18 months, 60 months). Of the cases followed up, 9.86% of patients had recurrent chest pain. The median recurrence period was 36 months, with 95% confidence intervals from 18 to 36 months. Average follow-up: 48.8 months (18 months, 60 months), 4.76% of patients died. Median survival was 57 months, with 95% confidence interval: 18 - 57 months.

There was no statistically significant difference between the two adjacent groups of the rotator-arteries in the left-Y-type with the proximal segment of the radial artery-the aorta with preoperative features with $p > 0.05$.

There was no statistically significant difference between two adjacent groups of the radial artery - the left internal thoracic artery in the Y-shaped manner with the proximal end of the radial artery - the aorta with the characteristics of: duration of mechanical ventilation, time of resuscitation treatment. Similarly, the results did not distinguish between two groups for postoperative complications as well as the incidence of recurrent chest pain, congestive heart rate, and mortality.

DISCUSSION

The study was made on left radial artery surgery in patients with right forearm and vice versa. Position the patient on his back, arms to his back, with his body at an angle of 90^0 . While taking a radial artery, need to be dislocated into the vein with attached veins, not ceiling analysis. Do not use electric blades. Take the radial artery up to the articulation of the arteries of the arm, which depends on how many graftings meet the length of the artery. There is one case where we take the graft through the laparoscopic surgery. There is no case of anemia of hand. We followed the 4-step screening process: Allen test (Edgar V. Allen 1929), measurement of

oxygen saturation in fingers; Doppler ultrasound to accurately measure the flow of radial arteries, cylindrical arteries and shallow hand. Before cutting the radial artery at the lower end, clamp the proximal end and open the far end to check the flow of the stems. In these four steps, the fourth step determining the flow of the stalk is most important. This allows us to re-evaluate the quality of the graft on the softness of the blood vessels, the calcification of the artery wall, the lumen of the vein and to ensure that there is no anemia for the hands after surgery. This may indirectly explain why we still choose rotating arteries in some patients over 70 years of age but the quality of the grafts remains fairly good, the arteries are smooth, not tight vascular barrier and good flow of blood vessels. This remark is similar to that of William Y. Shi¹¹. In the study, there were 12 cases of paresthesia and numbness in the forearm and hand, accounting for 8.16%, of which 9 cases improved after 1 year (6.12%). There are 2 cases of thumb, accounting for 1.36%. According to the literature, neurological damage can be permanent, with neurological injuries, neurological symptoms, paresthesia, numbness. Saeed reports a neurological outcome rate of 67.7%; Shapira reports 56% of patients with pectoral and forearm palsy; Denton reported a 30.1% overall complication rate. During the dissection, we observed under microscope and carefully manipulated so as not to damage the lateral and nerve fibers. We concluded that the more gently the operation is, the less arterial spasm is, the less damage for the inner layer of the graft is and the less damage for the nerve is. Thus, the rate of complications in the forearm and hand after radial artery graft surgery is acceptable, no higher than the data recorded in the literature and no serious complications are found for safety and effectiveness of this technique.

The study evaluated early results, having 59.18% good and 36.73% fair ones. The reports of Acar¹ and his colleagues gave good early results. The results of the two-week postoperative follow-up rate were 99% and 92% after 1 year. Signs of severe narrowing and rare string sign are noted; The rate of complete radial artery bypass grafting was 89.3%.

Chen studied vascular imaging studies performed on 94 grafts. The preoperative rate of follow-up in this study was 95.7%. The rest of the blockage was due to a technical error, due to the competitive flow of the puzzle piece, or unknown causes. Choosing the location of the target coronary artery for connecting to the radial artery is very important. We often have connect a radial artery with the target artery as bypass of the left coronary artery. It is extremely limited and it is important to consider radial artery grafts in cases of impaired renal function and the risk of venous thromboembolism for dialysis after surgery. Another contraindication for the use of rotary arteries is that of narrowing the artery because it can lead to the risk of ischemia in the leg and hand after surgery. There were no cases of death within 30 days after surgery. The rate of postoperative complications in people at the age of 70 years or older was 47.8%, higher than that of those at the age of less 70, the difference was statistically significant at $p = 0.002$ (<0.05). The complication rate in patients with $EF \leq 40\%$ was 60%, which was almost twice as high as in patients with $EF > 40\%$, the difference was statistically significant at $p < 0.05$. This finding is consistent with other authors' reports, the rate of complications and deaths are dependent on factors such as age, left ventricular ejection, emergency surgery situation or program.

The use of radial artery grafts was initiated by Carpentier et al. in 1971¹³. Since then, many other studies have used this graft, as studied by Gaudino et al in Rome, Acar and colleagues at Bichat Hospital in collaboration with Carpentier et al at Broussais Hospital, Calafiore⁵ et al in Chieti, Italy. Have used the radial artery graft more and more. In our study, the rate of brachial reconstruction in the left and right thoracic arteries was 98.77%, one of the radial artery was 92.85% and the one of saphenous vein graft was 82.5%. This is a very positive result for the internal thoracic artery and radial artery.

In the mid-term mortality survey, we found no difference in mortality between males and females ($p > 0.05$). Mortality in patients aged ≥ 70 years was 2.2%, higher than that of patients under 70 years of age, but this difference was not statistically significant, $p > 0.05$. Similarly, chest pain, myocardial infarction, ejection fraction, surgical circumstances in patients were not associated with mortality in patients, $p > 0.05$. However, in the study by Tranbaugh R.F⁹. For patients at the age of less than 70 years, it is preferable to use the right artery as a second graft after the left internal thoracic artery.

Table No.1: Ultrasound and preoperative angiography results

S.No		Frequency	Ratio (%)
Damaged coronary artery grafts			
1	2 grafts	24	16.3
2	3 grafts	123	83.7
General body narrowness (n = 51)			
3	Upper narrow 50%	34	66.7
4	Upper serious narrow 90%	17	33.3
Left ventricular total blood fraction			
5	$EF \leq 30\%$	5	3.4
6	$30\% < EF \leq 40\%$	15	10.2
7	$40\% < EF \leq 60\%$	58	39.5
8	$EF > 60\%$	69	46.9

(Source: summed up by the author)

Table No.2: Number of artery and vein grafts used

S.No		Frequency	Ratio (%)
Artery graftings			
1	1 grafting	1	0.7
2	2 graftings	86	58.5
3	3 graftings	51	34.7
4	4 graftings	8	5.4
5	5 graftings	1	0.7
Vein graftings			
6	Un-used vein	26	17.7
7	1 grafting	73	49.7
8	2 graftings	47	31.9
9	3 graftings	1	0.7

(Source: summed up by the author)

Table No.3: Complications after surgery

S.No	Complication	Frequency	Ratio (%)
1	Re-surgery	3	2.04
2	Infection of incision	11	7.48
3	Sepsis	6	4.08
4	Urinary tract infections	4	2.72
5	Neurology: cognitive disorder	2	1.36
6	Preumonia	20	13.61
7	Kidney failure	4	2.72
Treatment of kidney failure (n=4):			
8	Not treatment	2	1.36
9	Internal treatment	1	0.68
10	Kidney dialysis	1	0.68
Cardiovascular (n=19):			
11	Atrial fibrillation	4	2.72
12	Heart failure	15	10.20
13	Multi-organ failure	1	0.68

(Source: Summed up by the author)

Table No.4: Connecting features of the radial artery - thoracic artery in the Y-shaped manner and radial artery - aorta

S.No	Variables	Y – Shaped connection (n= 30)	Connecting to the aorta (n = 117)	p
1	Feminine	8 (26.7)	29 (24.8)	0.832
2	Age of above 70	6 (20.0)	40 (34.2)	0.135
3	Diabetes	15 (50)	29 (24.8)	0.07
4	Chronic kidney failure	3 (10)	4 (0.4)	0.131
5	Chronic obstructive pulmonary disease	2 (6.7)	3 (5.7)	0.269
6	Angioedema	5 (16.7)	18 (15.4)	0.863
7	Unstable angina and subacute myocardial infarction	13 (43.3)	62 (52.9)	0.345
8	Ejection rate EF ≤ 40%	1 (3.3)	19 (16.2)	0.066
9	Causes of acute or subacute surgery	5 (16.7)	18 (15.4)	0.863
10	Mitral valve surgery	2 (6.7)	7 (5.9)	0.889

(Source; Summed by the author)

Table No.5: Results of connecting the end close to the radial artery - left internal thoracic artery in the Y-shaped manner and radial artery – aorta

S.No	Variables	Connecting the left internal thoracic artery in the Y-shaped manner (n= 30)	Connecting to the aorta (n = 117)	p
1	Surgical time (minutes)	349.3	335.6	0.33
2	Duration of mechanical ventilation (hours)	27.5	21.0	0.533
3	Duration of treatment at resuscitation (day)	3.4	3.0	0.469
4	Meningitis and mediastinum	2 (6.67)	7 (5.9)	0.889
5	Neurological complications after surgery	1 (3.33)	1 (0.8)	0.296
6	Acute renal failure after surgery	2 (6.67)	2 (1.7)	0.137
7	Multidisciplinary Imaging After Surgery	1 (3.33)	0	0.051
8	Recurrent chest pain	3 (10.0)	11 (9.4)	0.921
9	Post-surgical grafting congestion	2 (6.67)	5 (4.27)	0.583
10	Mid-term mortality	0	7 (5.9)	0.170

(Source: Summed up by the author)

Table No.6: Comparison of results with authors using whole artery graft

S.No	Author (year) Follow up duration	Follow up duration	Early death (%)	Myocardial infarction (%)	Recurrent chest pain (%)	Mid-term survival (%)
1	Zacharias (2009) ¹²	28 ± 23 months	1.2	----	8.5	94 ± 3.5
2	Damgaard (2009) ⁴	11 ± 2 months	0.6	1.2	2.5	89 ± 11
3	Tranbaugh (2012) ⁸	15 years	0.3	0.8	----	75
4	Vu Tri Thanh (2016)	55 ± 4.8 months	0	0	7.69	92.31

(Source: Summed up by the author)

Table No.7: Comparison of mid-term connection rate of radial artery

S.No	Author	Follow up term	Total radial artery graftings evaluated	Radial artery graftings being connected
1	Acar <i>et al</i> (1992) ¹	9.2 months	56	100%
2	Califiore <i>et al</i> (1995) ³	77 ± 16 months	76	98.7%
3	Iaco <i>et al</i> (2001) ⁵	48 ± 27 months	74	98.6%
4	Maniar (2002) ⁶	27.1 months	1022	70
5	Tatoulis (2009) ¹⁰	48.3 months	590	89
6	Achouh (2012) ²	7 year	563	82.8
7	Tranbaugh (2012) ⁸	8.1 year	1851	82
8	Vu Tri Thanh(2016)	55 ± 4.8 months	147	92.85

(Source: summed up by the author)

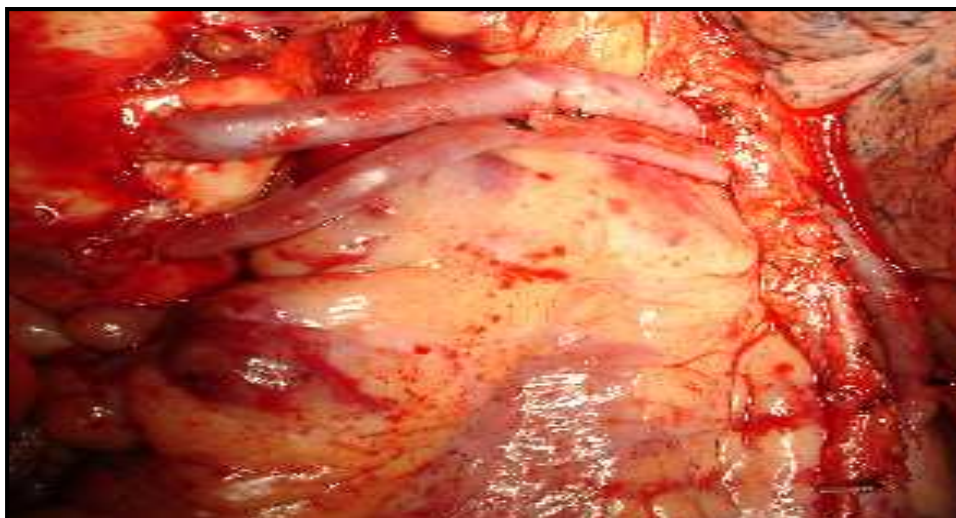


Figure No.1: Connecting the end close to the radial artery to the aorta before connecting to the coronary artery

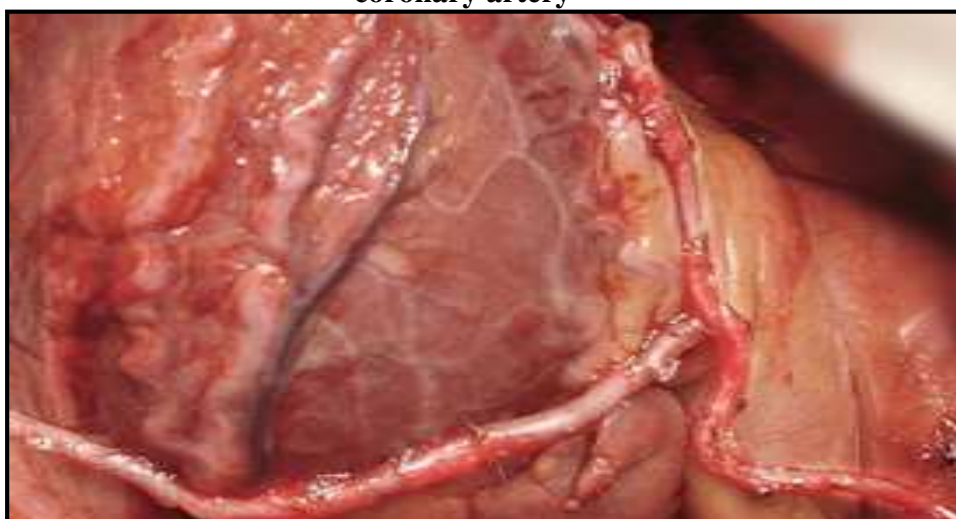


Figure No.2: Connecting the end close to left Internal Thoracic Artery in the Y-shaped manner before connecting the coronary artery

(Source: The author conducted for Patient Nguyen Cong B - SHS: 08-0005594)

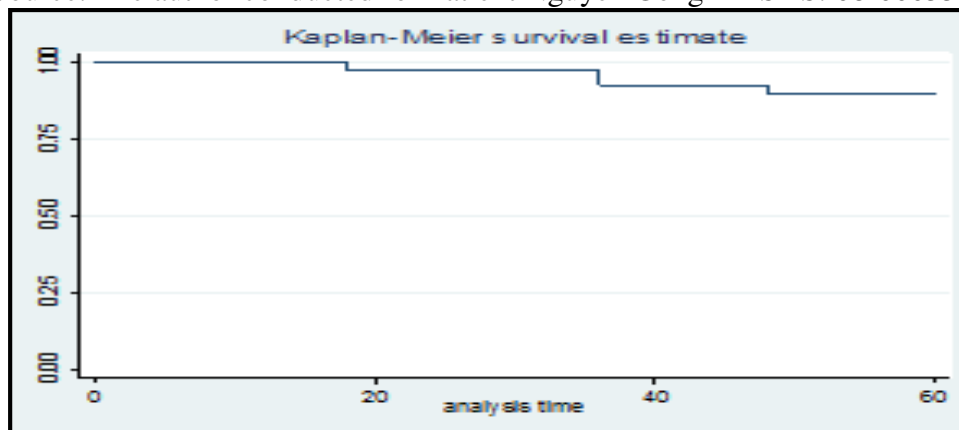


Figure No.3: Time without recurrent chest pain

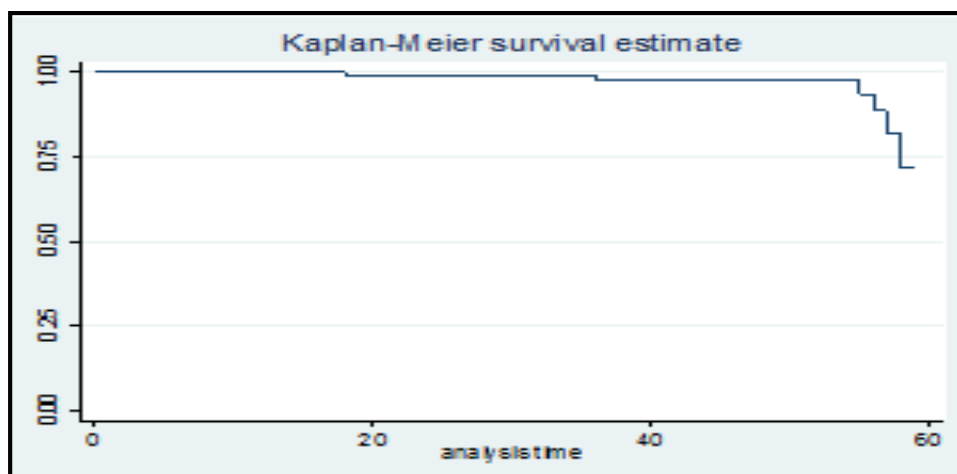


Figure No.4: mediocre survival time

CONCLUSION

Use of radial artery graft in coronary artery bypass graft surgery is for good results and rate of articulation. After an average follow-up of 49.8 months, the rate of recurrent chest pain was 90.14%, the rate of radial artery grafts was 92.85%, the mortality rate was 4.76%. The complication and mortality rate is dependent on the age factor of over 70 and the left ventricular ejection fraction below 40%. Taking a radial artery graft is feasible, safe and effective if complying with right techniques and in combination with anti-spasm medicines, especially the role of calcium channel blockers.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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