

# Free Radial Artery as an alternate Conduit in CABG

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**Objective:** This study was under taken to explore the potential of the Free Radial Graft as a safe efficient and suitable alternative conduit in coronary artery bypass grafting incase of in availability of the more established conduits like the IMA and Great Saphenous Vein graft especially in redo surgery. **Method:** This prospective randomized single center trial was conducted on three groups of patients under going CABG. The study was conducted from 1<sup>st</sup> January 1999 to December 2002. The first group A (n=15 with mean age of 47.05±8.35years) Radial artery was used for grafting in Right and Left sided grafts except the LAD. In the second group B (n=15 with a mean age of 54.80±11.14 years) Great Saphenous Vein was used for grafting in Right and Left sided grafts except the LAD. In the third group C (n=20 with a mean age of 55.93±11.14 years) IMA was only grafted to LAD. Proximal ends of both the GSV and the Radial Artery were anastomosed to the Aorta. All patients were male. Follow up was done in these patients both by non invasive and invasive methods such as ETT, Thallium scan, Angiography. Comparison was mainly done between the Radial artery and the Great Saphenous Vein taking as granted that the IMA is the best graft for the LAD in all cases. **Results:** IMA was always applied to LAD in all patients in the three groups. In group (A) Radial Artery was grafted to RCA in 5 (33.3%) pts. Diagonal in 4 (26.7%)pts. Obtuse Marginal 12(80%) pts. And PDA 3 (20%) pts. In group (B) Great Saphenous Vein was grafted to RCA in 6(40%)pts. Circumflex 1(6.7%)pts. Diagonals 2 (13.3%) pts. Obtuse marginals 6 (40%) pts. And on PDA 4(20%) pts. All patients were regularly followed up for 18 months to 24 months. Post operative angina was reported in 2 (13.3%)pts. in group A and 5(33.3%) pts. In group B (p=0.549). ETT was done in all these pts. Was positive in 1(6.7%) in group A and 2 (13.3%) in group B (p=0.309). Thallium scan was done in all the study population and was found positive in 4 (26.7%) in group A and 5 (33.3%) in group B Patients(p=0.265). Coronary angiograms were done on 10 patients out of each group. In group A the grafts were patent in 9 patients (90%). In the group B the grafts were found patent in 8 (86%) patients.(p=0.543). Moderate Graft stenosis was found in 01 patient in group B and none in group A (p=0.35). Totally blocked grafts were found in 01 patients in each group (p=1.00). **Conclusion:** On the basis of this study early results suggest that Radial Artery graft is a suitable, safe, and potentially effective alternative in CABG patients. Early graft patency in patients receiving RADIAL ARTERY grafts is comparable to those receiving Saphenous Vein grafts. It may prove an excellent alternative for those who do not have the traditional conduits available due to any reason. However this short follow up period is not sufficient to come to a firmly conclusive result. A long term study with graft angiography is required to prove the efficacy of this conduit for future use

**Key words:** CABG, Radial artery, alternate conduit.

The fates of the long term survival of the patient is partly dependent on the type of the conduit used. It has been established that the IMA is the best conduit for long term patency wise<sup>1</sup>. Left and right Internal Mammary arteries have similar patency rates if applied to the LAD. But the patency rates of the free IMA grafts are inferior to those which are applied with their pedicles intact<sup>2</sup>.

Great Saphenous Veins have shown good early results patency wise. But it has been shown that by the end of ten years 40% of the grafts may have totally failed.<sup>3</sup> This has led to search for an alternate arterial graft which may be used if and when required. For this purpose radial artery, inferior gastric, Rt. gastroepiploic arteries have been tried. All have shown good results symptomatically. But very few angiographic studies have been conducted regarding the patency.

The first series of radial artery grafts were done in the early 1970s by Carpentier et al<sup>4</sup>. Although the early results were good it was found that the conduits occluded very rapidly which was attributed to denervation and increased sensitivity of the artery to the circulating catecholamine<sup>5</sup>.

Curtis et al suggested intimal hyperplasia as the cause of graft occlusion<sup>6</sup>. The hyperplasia was considered to be due to trauma during harvesting. Due to high rate of failure Curtis et al suggested to discontinue the use of radial artery as a conduit.

Reasons for discontinuation were

1. High occlusion rates due to spasm and intimal hyperplasia.
2. Potential harmful effects of radial artery harvesting on vascular and neurological supply on the donor arm.

Poor performance of the radial artery was later attributed to tendency to spasm and increased intimal growth due to endothelial injury caused by use of graduated probes during graft preparation<sup>7</sup>.

Radial artery grafts were re introduced into the clinical practice in 1989. Dr Carpentiers original grafts were found patent in some of the patients 15 years later. Acar et el 1992 and Calafiore et el 1994 described conduit patency at 93% and 94.1 %at 6 to 9 months<sup>8</sup>.

The revival of the Radial artery in the 90s was attributed to the following factors

1. Better harvesting techniques.

2. Use of calcium channel blockers .
3. Better pharmacological control of the artery spasm .
4. Use of post operative antiplatelets and anticoagulation therapy .

Radial artery is gaining more popularity as a conduit. There have been reports of fewer complications like haematoma and ischemia of the donor site. Patients have a better prognosis regarding lower sternal infection rates . Although the results of the free Radial graft have been encouraging there have been few studies comparing these RA grafts to the SV or IMA grafts. There is one study originating from Toronto comparing patency between RA and SV known as radial artery patency study<sup>9</sup> (RAPS) .One study in which patients have been prospectively randomly assigned to receive RA or an other bypass conduit is (RAPCO) Radial artery patency and clinical outcome<sup>10</sup>.

In this prospective randomized study aim was to study the early results and efficacy of the radial artery graft as an alternative conduit to more popular and in vogue conduits using all the modern investigative techniques including ETT, THALLIUM SCAN, ANGIOGRAPHY etc. all the patients received IMA grafts as the superiority of the IMA as the best conduit was not challenged. The comparison was mainly done between the RA and SV grafts.

#### Materials and Methods

**Study Design:** In this randomized study conducted at the Punjab Institute of Cardiology 50 CABG patients were studied. These were divided in to three groups, group A patients receiving RA grafts Group B patients receiving SV grafts and Group C patients receiving LIMA to LAD grafts. All the patients received LIMA to LAD grafts in all the groups. Age of the patients was < 70 years. All were males. Comparison was done between group A and group B regarding the recurrence of the symptoms and the patency of the grafts . Both invasive and non invasive procedures were employed from interval of 6 to 24 months to assess the symptoms and to find out the patency of the applied grafts.

**Hypothesis:** Radial artery is a suitable, safe ,and effective alternate conduit to the more traditional conduits especially in the situation in which these conduits are not available due to any reason.

**Specific Aims:** This study was under taken to specifically study the Free Radial Artery graft as an alternate conduit in the case of unavailability of the more traditional conduits due any reason. Also to compare its safety efficacy and suitability as compared to the SV grafts using both the non Invasive and the invasive investigations available at our centre.

#### Inclusion criteria

- Patients under 70 yrs under going elective bypass procedure .

- Males requiring revascularization procedure.
- Unavailability of the IMA and or the SV due to any reason like varicose veins dissection injury of IMA, or Re do surgery .
- Total arterial revascularization.

#### Exclusion criteria

- Positive Allen's Test
- Abnormal upper extremity Doppler study.
- Any vascular disease like vasculitis ,scleroderma , Raynaud's disease, Rheumatoid arthritis, Carpal tunnel syndrome , documented sub clavian stenosis ,
- Previous vascular trauma, prior arterial cannulation ,
- Surgery on the fore arm which may have led to fibrosis.

**Random assignment:** All patients received an insitu left internal mammary artery graft to the LAD. Choice of the second graft was randomized and if an additional graft was required an SV graft was used. Therefore in group A patients received RA graft as first choice for the second anastomosis followed by SV grafts if more conduits were required . In group B Saphenous Vein grafts were used in all case except in case of LAD where IMA was used as the preferred conduit.

**Preoperative medications:** Most of the preoperative medications were discontinued until the time of surgery. Beta blockers , ACE inhibitors and calcium channel blockers were continued till the time of surgery. Platelet inhibitors were discontinued at least 7 days before , and coumarin was discontinued 4days before surgery. For anticoagulation in pts especially on coumarin heparin infusion was used and APTT kept around three times that of control . Digoxin was stopped 30 hrs prior to surgery.

**Surgical technique:** The Internal Mammary artery , the Radial Artery and the Great Saphenous Vein were harvest at the same time. The IMA and the GSV were harvested in the routine manner. Allen's test was routinely performed on candidates for the radial artery graft which was harvested from the non dominant arm. The incision was made from the wrist to the non cubital fossa and then the artery exposed from beneath the Brachioradialis muscle. After incision and exposure the branches were clipped with haemostatic clips . At this point an intra operative Allen's test was performed by clamping the RA and watching for pulsation distal to the clamp. A visible or palpable pulse was taken as a sign of adequate collateral blood flow via the Ulnar artery and the palmer arch. Clamp was removed after confirming the collateral flow and the artery was wrapped in papaverine soaked gauze and the blood flow was maintained till after the pt. went on to the CPB. Radial artery was then removed avoiding manipulation by forceps. Gentle hydrostatic dilation was done with a papaverine and blood solution ( each 4ml of the solution contained 1ml(1gm) papaverine and 3 mls of blood. retrograde infusion was also done to check for any leaking branches. The graft was then stored in papaverine

and blood solution till the time of application. The distal end was anastomosed to the target vessel and the proximal end to the Aorta . The incision in the donor arm was sutured closed and a loose dry dressing was applied. Pressure dressing and woven elastic bandages were avoided to prevent any alteration of flow of blood to limb.

**Post operative management:** The donor arm was monitored for the unlar pulse , temperature , color , capillary filling time, sensation and movement . In the ICU these parameters were monitored every 02 hours and later every 04 hours till discharge from the hospital. Oxygen saturation was monitored from both arms for comparison with a pulse oxymeter . No invasive or non invasive monitoring of the donor arm was done . The arm was loosely dressed and no elastic pressure bandage was applied. No IV line taken on the donor arm. And the arm was not elevated too much . The patient was allowed to take care of the arm and to use it on the second postoperative day. ECG changes were monitored to look for any vasospasm .

**Post operative Medication regimen:** The most important aspect of the pharmacological consideration was to prevent smooth muscle spasm and to promote the relaxation of smooth muscle of the graft. Initially IV nitroglycerine 2 mg/kg per minute was started after coming off the bypass. Later after extubation pt was started on 180 – 240 mg of diltiazem which was continued till 6 to 12 months post ops. Individual use and dosages may vary depending on the condition of the patient and the preference of the primary physician

**Results:**

In the current study the 50 patients were studied and a comparison was made between the SV and RA grafts patency in the 18 to 24 months post operative period. Both the groups had 15 patients each. The internal mammary artery was applied to the LAD in all cases and studied but not included in the comparison due to its known patency rates.

In group A mean age was 47.04+ 8.93 yrs. Diabetes 66.7%,Hypertention in 47.7%, previous MI 20% , Unstable Angina in 13.3%, atrial fibrillation in 6.7%, positive family history in 60%.mean ejection fraction 48± 7.02. the mean operating time was 4.02+ 1.08 hours. Aortic cross clamp time was 47.13+ 16.63 minutes. Dobutamine was given in 10(66.7%) while Dopamine infusion was started in all patients 15 (100%).no patient had adrenaline or intra aortic balloon see tables.

Table:1 Epidemiological Characteristics

Characteristics	RA	GSV	P value
Age mean years	47.04±8.39	54.80±11.14	55.93±11.14
Male	15(100%)	15(100%)	20(100%)
DM	10(66.7%)	7(46.7%)	9(45%)
Hypertension	7(46.7%)	7(46.7%)	9(45%)
Smoking	9(60%)	13(86.7%)	13(65%)
Hyperlipidemia	13(86.7%)	10(66.7%)	8(40%)

Table: 2. Comorbidities of the study population (n=15)

Comorbidities	RA	GSV	P value
Previous MI	3(20%)	3(20%)	2(10%)
Unstable angina	2(13.3%)	1(6.7%)	1(5.0%)
Atrial fibrillation	1(6.7%)	0	1(5%)
F/H of IHD	9(60%)	11(73.3%)	8(40%)
COPD	0	0	1(5%)
Ejection fraction mean percentage	48±7.02	46.66±7.94	55.66±9.6

In the group B mean age was 54.80+ 11.14. Diabetes 46.7%, hypertension 46.7%, previous myocardial infarction 20%, unstable angina 6.7%, atrial fibrillation in 0%, positive family history in 73.3%.the mean operating time was 4.26+ 1.65 hrs and mean cross clamp time was 36.33+ 10.60 minutes. Dobutamine was started in 66.7%(10pts) and dopamine in 73.3 % (11pts). Adrenalin infusion given to 20% (4pts) ,none were put on IABP.

LIMA was always applied to LAD in all three groups. Mean ICU stay in group A was 24.46 hrs+ 3.35 hrs. post operative stay was 8.06 + 1.48 days. Pneumonia was observed in 02 pt. medianitis in 01 pts. Post ops low cardiac out put , CVA, or respiratory failure was seen in none. None expired in group A. in group B ICU stay was 23.80+ 3.89 hrs. and hospital stay was 8.73+ 1.57 days. Post ops low cardiac output was seen in 01 pts , pneumonia in 03 pts. No other complications seen . none expired in group B see tables.

Table: 3 Operative data (n=15)

Characteristics	RA	GSV	P value
Intubation time mean (hours)	4.2±1.08	4.26±1.66	3.86±1.65
Adrenaline	0	3(20%)	4(20%)
Dobutamine	10(66.7%)	10(66.7%)	17(85%)
Dopamine	15(100%)	11(73.3%)	20(100%)
IABP	0	1(6.7%)	0
AXC time mean (minutes)	47.13±16.63	30.00±10.82	36.33±10.60

Table: 4 Distribution of grafts (n=15)

Gps	RCA	Circum flex	Diagonal	OM	PDA
RA	5(33.3%)	0	4(26.7%)	12(80%)	3(20%)
GSV	6(40%)	1(7%)	2(13.3%)	6(40%)	4(27%)

Table: 5 Post Operative outcome of the study population (n=15)

Characteristics	RA	GSV	P value
ICU stay time mean (hours)	24.46±3.3	23.80±1.57	22.80±2.86
Post op stay mean (days)	8.06±1.48	8.73±1.57	8.13±1.12
In hospital mortality	0	0	0

Post operative angina was seen in 02 (13.3)pts in group A and 5(33.3%) in Group B. (p=.549) . ETT positive in 01 (6.7%)in group A and 02 (13.3%) in group B. (p=0.309). Thallium scan was positive in 04(26.7%)in group A and 05 (33.3%) in group B.(p=0.265). Angiography showed graft patency in >90% in group A and about 86% in group B. (p=0.543). moderate graft stenosis was observed in only

one patient in group B. totally blocked grafts was seen in only one patient in group B (p=1.000) see tables

Table 6 Postoperative Course of coronary artery disease in the study population (n=15)

Signs	RA	GSV	P value
Post op angina	2(13.3#)	5(33.3%)	0.549
Post op +ve ETT	1(6.7%)	2(13.3%)	0.309
Post op +ve thallium scan	4(26.7%)	5(33.3%)	0.265

Table 7: Postoperative graft study (n=10)

Post op angiography	RA	GSV	P value
Graft stenosis	0	1(10%)moderate	0.35
Graft blocked	1(10%)	1(10%)	1.000
Graft patency	9(90%)	8(86%)	0.543

**Discussion:**

The higher patency rate and survival incidence in patients with a left internal mammary artery grafted on the left anterior descending coronary artery is well established<sup>11</sup>. The evidence of left internal mammary artery patency more than 21 years after the implantation supports these results strongly<sup>12</sup>. Superior results of left internal mammary graft in coronary artery bypass surgery, encouraged the surgeons to explore more arterial conduits. The right internal mammary artery, right gastroepiploic, inferior epigastric and radial arteries have been used as conduits for coronary artery bypass grafting in the pretext that these will provide long term patency and survival. Carpentier et al<sup>11</sup> introduced radial artery grafting in the early 1970s as an alternative conduits. In their initial work, the patency rate was 90% at 1 to 10 months. However, within 2 years, angiography revealed narrowing of the graft in 15 (35%) of the 42 patients who received radial artery grafts, and 3 (7%) had reoperation. Carpentier suggested that the stenosis of the arterial graft was related to spasm of the denervated artery<sup>13</sup>. Some investigators<sup>3</sup> have proposed that denervation of the free arterial graft at the time of removal may cause the graft to become hypersensitive to the vasoconstrictive properties of circulating catecholamines. Because of the high prevalence of stenosis or occlusion, researchers concluded that the radial artery should not be used until the physiological problem of spasm was resolved<sup>13</sup>. Subsequent studies found that radial artery grafts occluded at a higher rate than did other simultaneously placed IMA or saphenous vein grafts<sup>14</sup>. Curtis et al<sup>6</sup> suggested that intimal hyperplasia was the major cause of failure of radial artery grafts. In their investigation, 79 patients received radial artery grafts, and 29 of the 79 had angiography 2 to 12 months after the surgery. Of 34 grafts in the 29 patients, 22 (65%) had either occlusion or severe generalized stenosis. Histological examination of removed grafts revealed marked intimal hyperplasia, luminal narrowing, and occlusion. Occlusion due to intimal hyperplasia was thought to be caused by trauma associated with harvesting (the use of manual dilators), preparation techniques (the use of hydrostatic pressure), and ischemia. Because of the

high rate of failure, Curtis et al<sup>6</sup> recommended that the radial artery no longer be considered as an alternative conduit for aortocoronary bypass. All these groups abandoned the use of radial artery as a conduit. The reasons for the discontinuation of the use of radial artery graft were:

- High early occlusion rates due to spasm and intimal hyperplasia.
- Potential deleterious effect of radial artery harvesting on vascular and neural supply of the donor arm.

The poor performance of the radial artery as a graft was later attributed to the tendency of the denervated artery to become spastic, as well as to accelerated intimal hyperplasia, which might result from endothelial injury caused by the use of graduated probes during the graft preparation process. The radial artery was reintroduced into clinical practice in 1989. In 1992, Acar et al reinvestigated the use of the radial artery for coronary artery bypass grafting. They found that some of the radial artery grafts from Dr. Carpentier's patients were functioning after 15 year<sup>8</sup>. Acar et al reported the patency rate of the radial artery graft as 93% at 9 months. Calafiore and his colleagues in Italy used radial artery in 1991 and reported their experience in 1994. They achieved 94.1% conduit patency with a 6 to 9 months follow up in 17 patients<sup>13</sup>. Since then, several cardiac centers all over the world used radial artery conduit for coronary artery bypass grafting and confirmed these results<sup>15</sup>. The revival of the radial artery graft in early 1990's was mainly due to the following improvements and advances in the coronary artery bypass grafting. Better harvesting techniques. The use of calcium channel blocking agents.

- Better pharmacological control of graft spasm.
- The use of postoperative antiplatelets and anticoagulation therapy.

In our study the Radial artery graft was examined along with Internal Mammary Artery and Great Saphenous Vein, although the angiographic follow up period (6-18 months) was relatively short, the graft patency was (90%) good. In this study the end point graft patency was 100% in IMA group, 90% in RA group and 89.47% in SVG group. In this study we compared safety, suitability and efficacy of Radial artery and great saphenous vein grafts. In great saphenous vein group graft patency was almost equal to the Radial artery group 89.47%. In studies by Acar<sup>8</sup> Chen and Affonso da Costa<sup>17</sup> and their associates, the early patency rate of SVGs was reported as 88.9%, 92.3% and 92.8% respectively. There are two randomized trials that have analyzed graft patency as an endpoint<sup>18</sup>. Fremes<sup>19</sup> and the RAPS investigators have enrolled 560 patients in a prospective multicentre randomized clinical trial comparing the RA patency with that of the SVG when grafted to the right or Circumflex coronary arteries. Better harvesting technique has played an important role in the revival of radial artery grafts. Improvement in both the graft patency and harvest site complication has been

reported by various groups. Invasive and non-invasive diagnostic tests for collateral supply of the hand has diminished the donor arm and hand complications with good quality of the conduit. The assessment of adequate ulnar collateral supply to the hand is mandatory prior to the harvest to the radial artery as a conduit for coronary artery bypass grafting. Galinanes et al<sup>20</sup> described their technique, which involves assessing the presence of a hyperemic flow response to occlusion of the radial artery using an intraoperative transit time meter. They found this technique to be objective and reliable. Roderiguez et al<sup>21</sup> described the role of preoperative radial artery ultrasound and digital plethysmography prior to coronary artery bypass grafting. They used doppler ultrasound and digital plethysmography to determine the suitability of radial artery for harvest prior to coronary artery bypass grafting. Criteria used to exclude radial artery from harvest were anatomic abnormalities (size <2mm, diffuse calcification), and perfusion deficits during radial artery occlusion (>40% reduction in digital pressure, non-reversal of radial artery flow). They concluded that doppler ultrasound and digital plethysmography identifies both perfusion and anatomical abnormalities of the radial artery<sup>21</sup>.

In our study arm complications were not significant, 4(26.7%) patients developed minor arm swelling, 5(32.3%) patients developed parasthesia and 9(60%) patients developed numbness. None of the patients had wound infection, wound dehiscence or limitation of hand movements. The risk of major arm complication like infection, ischemia, seroma or paresthesia from radial artery harvesting for coronary artery bypass grafting is low, even in patients of advanced age<sup>22</sup>. Brodman and colleagues in their study identified a mild reduction in digital perfusion and increase in ulnar artery flow velocity and diameter with no clinical sequelae or compromise in hand function after radial artery harvest in properly selected patients<sup>24</sup>. Denton et al<sup>24</sup> reported neurological complications in 30%, decreased thumb strength in 5.5%, and any sensation abnormality in 18.1% of patients, with a higher rate of symptom improvement over an average of 8-9 months. They concluded that over-all rate of self reported neurologic complications after radial artery harvest was higher than previously reported. These symptoms may be attributable to radial and median nerve injury caused by trauma and devascularization.

Amrani et al<sup>25</sup> reported the results of cross sectional survey of harvest site complications and qualities of life following coronary artery bypass using the radial artery. They concluded that sensory symptoms following radial artery procurement occur more frequently, but are largely self limiting and are usually clinically insignificant. Radial artery harvesting may be associated with lower wound infection rates and greater patient satisfaction. However, the presence of sensory symptoms may be of relevance when obtaining informed consent.

In our setup we used nitroglycerine infusion preoperatively and during immediate post operative ICU stay for vasodilator effect. We used Isosorbide Nitrate in all Radial Artery group patients and in hypertensive patients as we used Diltiazem and Nifedipine in selected patients for spasm prevention of radial artery grafts. The use of calcium channel blockers and other pharmacological agent contributed a lot towards the better control of radial artery spasm and its prevention. The radial artery spasm was one of the major exclusion criteria and reason for its abandonment in early 1970's. Bond et al<sup>26</sup> used different calcium channel blockers, including diltiazem, amlodipine and nifedipine for radial artery spasm prevention. They demonstrated that neuro hormonal factors released post-coronary artery bypass grafting can cause radial artery vasoconstriction and that calcium channel antagonists are not equally effective in abrogating that response. Both amlodipine and nifedipine appear to be the most in reducing radial artery vasoconstriction<sup>27</sup>. Sadaba et al<sup>28</sup> described the vasorelaxant properties of nicorandil on human radial artery. They concluded that nicorandil has a marked relaxant effect on contractions evoked by different vasoconstrictor agonists, and relaxes vasospasm that is resistant to conventional Ca<sup>++</sup> antagonists<sup>28</sup>. He et al<sup>29</sup> reported the vasorelaxant effect of phosphodiesterase inhibitor milrinone in the human radial artery. They concluded that milrinone is a potent vasodilator for the radial artery, with possibly higher potency in alpha-adrenoceptor and depolarizing agent (K<sup>+</sup>) mediated, but less potent in thromboxane A<sub>2</sub> mediated contraction. Because it has a positive inotropic effect, this vasodilator may be particularly indicated for use in patients receiving radial artery grafts in coronary artery bypass grafting<sup>30</sup>. Shapira et al<sup>31</sup> described the enhanced nitric oxide-mediated vascular relaxation in radial artery. They concluded that nitric-oxide dependent relaxation of radial artery is greater than that of internal mammary artery or saphenous vein. This difference is related to endothelial production of nitric-oxide and/or vessel sensitivity to nitric oxide. Such favorable physiological characteristics of radial artery could conceivably contribute to improved long term patency of this conduit compared with saphenous vein<sup>31</sup>. With current improvements in surgical harvesting techniques such as gentle or no hydrostatic pressure to prevent endothelial damage and use of drugs such as aspirin for platelet inhibition and calcium channel blockers (e.g. diltiazem) for prevention of spasm, the likelihood of long-term patency of radial artery grafts may be improved.

We used Papaverine, Heparin and normal Saline Solution to store Radial Artery at room temperature before grafting. This is effective solution in prevention of Radial Artery spasm. In our study no radial Artery spasm was noticed preoperatively. The storage or pretreatment of the harvested conduit is also helpful in the prevention of radial artery spasm before or after its use in coronary artery

bypass grafting surgery. Locker et al<sup>32</sup> reported that pretreatment with topical alpha antagonist solutions can inhibit radial artery vasoconstriction and cause dilatation for a longer period than achieved with papaverine. They concluded that topical treatment of radial artery with regiline (Phentolamine methansulphonic) increases radial artery free flow and is an effective intraoperative mean of decreasing radial artery spasticity

The use of anticoagulation and antiplatelet therapy post operatively has also resulted in improved radial artery grafts patency and reduced the incidence of early graft thrombosis in the postoperative course of coronary artery bypass grafting surgery. We used heparin 5000 IU subcutaneously three time a day till the patient is fully mobilized and life long use of aspirin 75mg per day is usually sufficient to avoid thrombosis. In our centre Radial Artery spasm was prevented successfully due to better harvesting technique with non touch technique, spasm prevention with spasm prevention with good pharmacological control and with use of vasodilator drugs. Better graft patency of the radial artery is the main objective of the study.

Calafiore et al reported long-term angiographic and clinical results of radial artery versus right internal mammary artery grafting. They concluded that in the long-term, lateral wall grafting with the radial artery provides the same clinical and angiographic results as right internal mammary artery grafting<sup>10</sup>. Acar et al<sup>33</sup> reported the clinical and angiographic results of radial artery at five years. They used the radial artery as a conduit in 910 patients undergoing coronary artery bypass grafting. A complete follow-up was obtained for the first 102 consecutive patients from 4 to 7 year after the operation they concluded that the radial artery for coronary artery bypass grafting provides excellent clinical and angiographic results at five years (83%). Possati et al<sup>34</sup> reported mid-term clinical and angiographical results of radial artery grafts used for myocardial revascularization. The patency and perfect patency rates of the radial artery 5 years after the operation were 91.9% and 87.0% respectively. The preoperative severity of the target-vessel stenosis markedly influenced the angiographic result. The calculated radial artery patency rates in Amano et al study was 91% at 2 years and 86.2% at 3 years. The longest angiographic follow-up of radial artery performed by Acar and associates, who reported radial artery graft patency rates of 99% in postoperative period 92% at one year and 83% at 5 years. Modification in the operative technique including non-traumatic conduit harvesting, spasm prevention with new pharmacological advances the use of antiplatelet therapy with coronary artery disease risk factor modifications resulted in better mid and long term radial artery graft patency rates. The use of Radial Artery free graft is now a safe, effective and suitable second alternative conduit for coronary artery bypass grafting.

## Conclusions

Radial artery is a relatively safe, suitable, and potentially effective alternative conduit for CABG. It is especially useful for the patients who may not have the other traditional grafts available due to any reason or cause. Early result show graft patency rates almost equal to the saphenous vein grafts. Provided that care in harvesting and appropriate drugs are used during and after harvesting. How ever a long term prospective randomized trial is required to assess the suitability of the graft in the longer term of ten to twenty year period.

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