The validity of Ipsilateral Internal Mammary Coronary Artery Bypass Graft of Left Upper Extremity Arteriovenous Fistula

Department of Cardiovascular Surgery, Saitama Medical University, International Medical Center

Jun Hayashi, Hiroyuki Nakajima, Toshihisa Asakura, Chiho Tokunaga, Masato Tochii, Akitoshi Takazawa, Kentaro Yamashita, Fumiya Chubachi, Yuto Hori, Atsushi Iguchi, Akihiro Yoshitake

Background

-The mortality rate of coronary artery bypass grafting (CABG) in hemodialysis (HD) patients has been generally accepted higher than patients without HD.
-Previous studies cautioned that the arteriovenous fistula (AVF) could cause steal of blood flow from the internal mammary artery (IMA) graft and myocardial ischemia during HD.
-The current issue may be the indication and strategy for the IMA grafting.

Objective

We examined clinical outcomes and the results of transit-time flowmetry (TTFM) during off-pump CABG and postoperative angiography. The purpose of this study is to delineate rationale of IMA grafting for HD patients.

Patient characteristics

	Ipsilateral N = 89	Contralateral N = 50	*p*-value
Age, years	68.1±8.9	64.6±10.1	0.04
Male, gender (%)	68 (76)	35 (70)	0.41
Hypertension	70 (79)	35 (70)	0.25
Dyslipidemia	51 (57)	24 (48)	0.29
Diabetes mellitus	62 (70)	29 (58)	0.17
DM nephropathy	57 (64)	27 (54)	0.25
Old myocardial infarction	46 (52)	31 (62)	0.24
Acute myocardial infarction	18 (20)	8 (16)	0.54
IABP	10 (11)	8 (16)	0.42
PCI history	23 (24)	13 (39)	0.58
Ejection fraction (%)	46.9±14.4	45.2±13.6	0.49
LVDd	52.6±6.6	52.5±7.4	0.95
LVDs	37.8±8.8	38.6±8.7	0.61
Severity of stenosis in LAD			0.83
Moderate (50-90%)	68 (76)	39 (78)	
Severe (99-100%)	21 (24)	11 (22)	
Stenosis location			0.42
Proximal segment (#5-6)	56 (63)	28 (56)	
Distal segment (#7-8)	33 (37)	22 (44)	
Left IMA to LAD	78 (88)	18 (36)	<0.01
BITA use	14 (16)	26 (52)	<0.01
All artery bypass	19 (21)	16 (32)	0.17
Number of target per patients	3.0±1.0	3.3±0.8	0.11

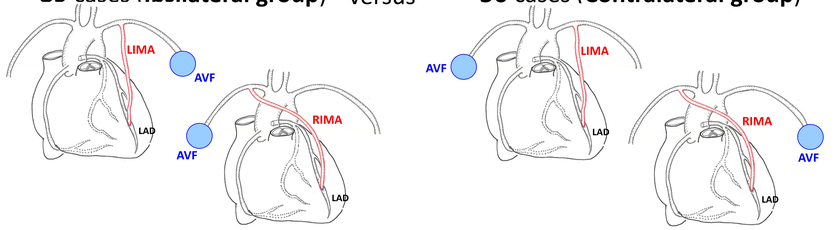
Patients

Period: Between April 2007 and December 2018
Off-pump coronary bypass grafting: 1,484 patients
→ 1,341 patients without hemodialysis
Hemodialysis patients : 143 patients
→ 3 patients without IMA-LAD
→ 1 Patient without preoperative data

139 patients: Hemodialysis patients IMA grafting to LAD

Which side of IMA is appropriate?

IMA to LAD;
ipsilateral to AVF
89 cases (**Ipsilateral group**)
versus
contralateral to AVF
50 cases (**Contralateral group**)



Results

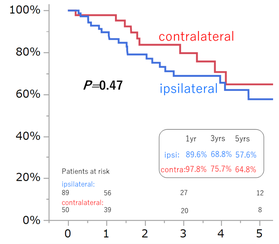
The whole cohort : N = 139

	Ipsilateral N=89	Contralateral N=50	
Flow ml/min	51.3 ±29.9	60.2±34.1	p= 0.13
PI	2.9 ±1.6	2.7 ±1.0	p= 0.36
DF (%)	72.6 ±11.9	73.1±11.8	p= 0.81
Patency (%)	55/56 (98)	34/35 (97)	p= 0.73

Early results

	Ipsilateral N=89	Contralateral N=50	P-value
Short term patency	55/56 (98)	34/35 (97)	0.73
Hospital mortality	0 (0)	0 (0)	-
Follow up period (yrs)	2.2±2.1	2.7±2.1	0.16

Late results -Overall survival-



LAD **Proximal** stenosis lesion : N = 84

	Ipsilateral N=56	Contralateral N=28	
Flow ml/min	50.9 ±23.6	57.5±32.9	p= 0.35
PI	3.0 ±1.7	2.8 ±0.8	p= 0.52
DF (%)	74.0 ±9.1	74.6±12.8	p= 0.84
Patency (%)	36/36 (100)	19/19 (100)	

LAD **Distal** stenosis lesion : N = 55

	Ipsilateral N=33	Contralateral N=22	
Flow ml/min	51.9 ±38.7	63.6±36.2	p= 0.26
PI	2.9 ±1.3	2.7 ±1.2	p= 0.58
DF (%)	70.1 ±15.3	71.2±10.3	p= 0.76
Patency (%)	19/20 (95)	15/16 (94)	p= 0.87

Moderate stenosis LAD lesion : N = 107

	Ipsilateral N=68	Contralateral N=39	
Flow ml/min	50.8 ±30.9	52.7±27.4	p= 0.74
PI	3.0 ±1.5	2.7 ±1.0	p= 0.36
DF (%)	74.0 ±9.1	72.8±12.3	p= 0.62
Patency (%)	44/44 (100)	26/27 (96)	p= 0.20

Severe stenosis LAD lesion : N = 32

	Ipsilateral N=21	Contralateral N=11	
Flow ml/min	52.8 ±26.8	86.7±43.3	**p= 0.03**
PI	2.8 ±2.0	2.7 ±0.9	p= 0.88
DF (%)	67.7 ±18.3	74.0±10.2	p= 0.23
Patency (%)	11/12 (92)	8/8 (100)	p= 0.47

Discussion

Although the graft is patent, the coronary blood flow is NOT satisfactory. **WHY ??**

LIMA-LAD N=161, all graft patients

	HD group	Non-HD group	*P* value
Pre-op. CFVR	1.81±0.52	1.93±0.66	*P* = .528
Post-op. CFVR	2.48±0.72	2.83±0.73	*P* = .042

Coronary flow velocity reserve, which can assess the function of the myocardial blood flow including **microcirculation**.

Honda et al. described that the microcircular disorders due to histopathological changes are found in patients with HD. It needs to adjust for the increased demand of the myocardial blood flow after coronary artery bypass grafting, but this microvascular remodeling causes inadequate vasodilation with endothelial dysfunction in HD patients and it may induce insufficient coronary flow increase.
Honda et al. J Card Surg. 2019;34:663-669

① **Decrease of endo-diastolic pressure due to AV fistula.**
② **Inadequate vasodilation with endothelial dysfunction in HD patients.**

Conclusions

Currently, off-pump CABG for HD patients was sufficiently safe, and therefore, even bilateral use of IMA was considered feasible. In revascularization of the LAD, the angiographic patency rate of the IMA ipsilateral to AVF was similar to that of the IMA contralateral to AVF. However, exclusively when the LAD has severe stenosis and the abundant graft flow is essentially expected, the IMA contralateral to AVF should be beneficial in terms of sufficient flow capacity.