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Long-term graft patency after CABG: effects of distal anastomosis angle

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The author has no conflict of interest to disclose with respect to this presentation

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Background

What do we know?

GRAFT PATENCY
Key determinant of long term outcome post CABG

GRAFT CHOICE
Additional arterial grafts (including RA)

COMPLETE REVASCULARIZATION
2-4 grafts /5-6 distal anastomoses

SURGICAL SKILLS
Composite grafting, sequential and Y/T anastomoses, conduit selection and preparation, graft/target vessel match

Factors affecting patency

- **Morphological features** (vessel type, graft length and diameter);
- **Physiological factors** (e.g. competitive flow, degenerative vascular changes);
- **Surgical parameters** – technical expertise, graft harvesting and preparation, grafting design and anastomosis technique (single, sequential, composite, Y/T, angle of anastomosis).

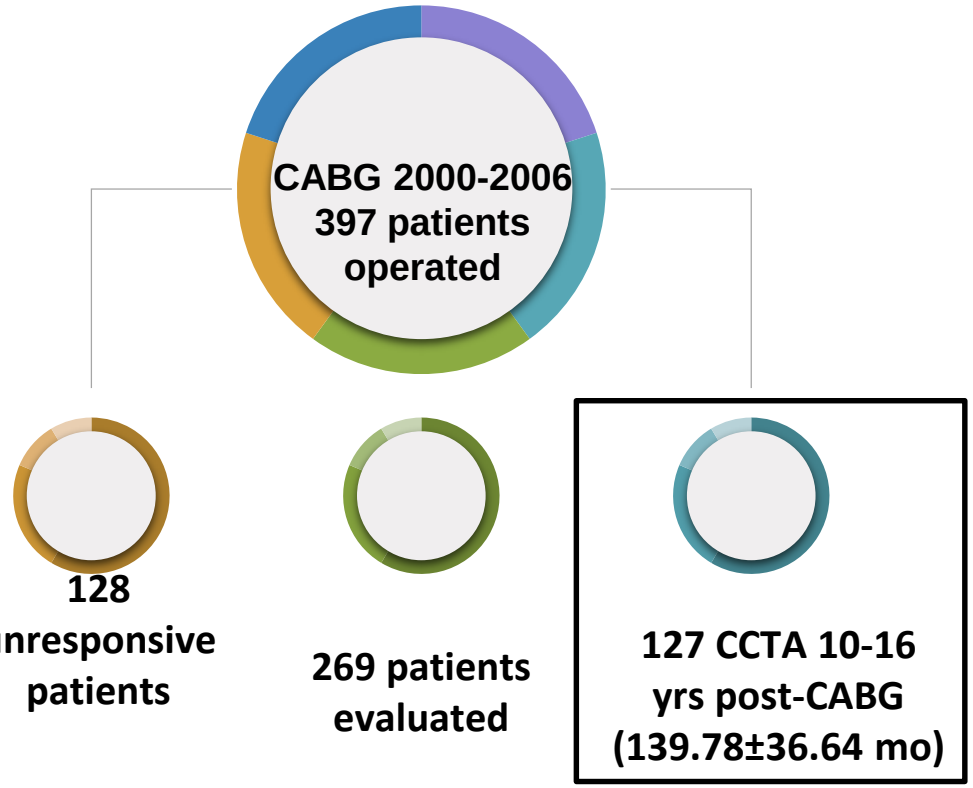
Nowadays it is considered that everything is almost known in terms of CABG surgery.
The optimal choice of conduit and configuration for CABG is still controversial. The weak point remains the correct intraoperatory evaluation of the factors that might influence long term graft patency.
There are few studies analyzing the most important morphological features to consider such as length, luminal diameter, wall thickness, and histological characteristics of the conduit.
This is why we try through this study to outline the surgical, morphological and physiological factors that might stabilize the results.

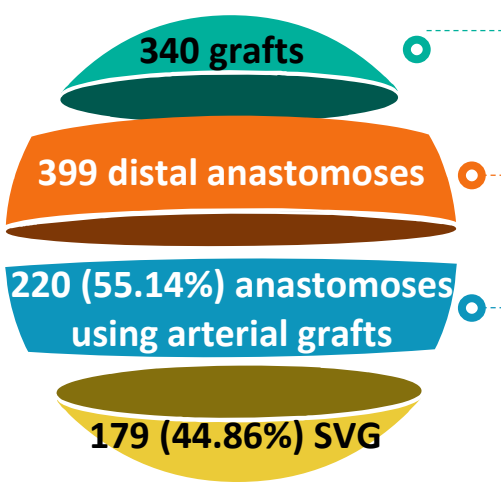
Which and how are the surgical, morphological and physiological factors associated with long-term grafts patency?

Study design and follow up

Evaluated graft variables :

- type and status (cfr OR protocol);
- target artery (cfr OR protocol);
- target vessel caliber;
- graft length and caliber;
- anastomosis type (cfr OR protocol);
- anastomosis angles.





2.68 grafts/patient

3.14 anastomoses/patient

122 LITA, 53 RA, 45 RITA

Postoperative medical treatment:

- beta blockers, statins, and enteric-coated aspirin in all cases;
- RA graft - calcium channel blocker (Amlodipine) for the first 3 months to prevent spasm;
- treatment adjusted according to the blood pressure, left ventricular ejection fraction (LVEF) and comorbidities.

■ Inclusion: more 10yrs

- First CABG
- Age > 18 years
- No contraindication for CCTA
- Good quality CCTA
- Informed Consent
- Complete medical file (demographic data; anthropometrical data - height, weigh; perioperative data, follow-up data)

■ Exclusion:less 10yrs

- Prior CABG
- No Informed Consent
- CCTA contraindications
- Poor quality CCTA
- Incomplete medical file.

Results

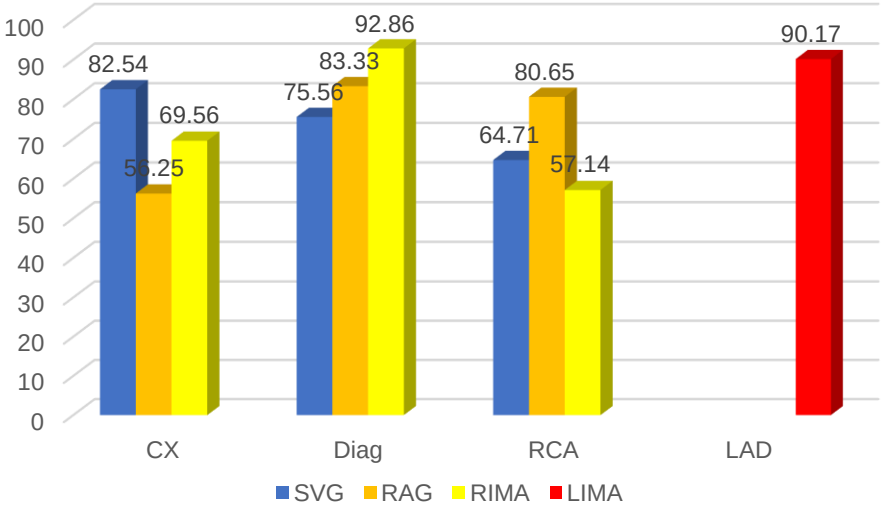
Patent grafts were longer and not tensed

	Patient's height (cm)			Graft's length (mm)		
	Patent	Occluded	p	Patent	Occluded	p
SVG	171	170	n.s.	133	122	n.s.
LIMA	170	172	n.s.	202	182	0.1
RIMA (Y)	171	165	0.06	96	84	0.08
RAG	174	168	0.06	133	114	0.1

Target vessel

Stenosis severity
3.02 occlusion OR for arterial grafts anastomosed to target vessels with <90% stenosis (p<0.001).

Vessel calibre (≤1.5 mm) being associated with 2.63 **occlusion** OR **for SVGs** (p=0.0041) **and** 2.31 occlusion OR **for arterial grafts** (p=0.0001)



Patency rates according to coronary territo

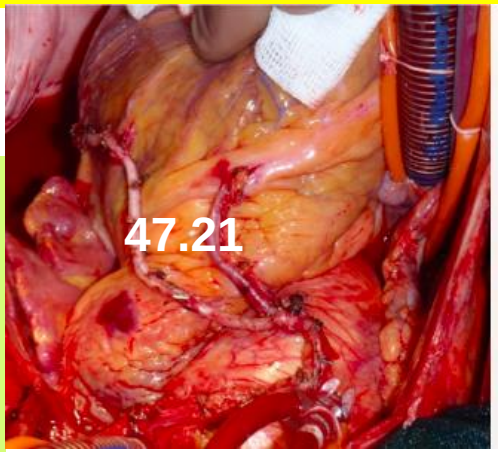
Proximal anastomosis type

Overall graft patency at 10 to 16 (11,6) years was of 90.17% for the LITA, 79.25% for the RA, 76% for the RITA, and 74.3% for the SVG.

Significant association of graft patency with proximal anastomosis type
0.110 occlusion OR (p = 0.002) for RA anastomosed to the ascending aorta - protective effect against graft failure.

Proximal (Y/T) anastomosis angle 47.21°

- ***mean angle*** **for Y/T anastomoses with both grafts patent - 47.21° vs. 56° for anastomoses with occlusion of the free arterial graft (RA or RITA).**
- **Significant difference between the anastomosis angle of patent versus occluded grafts (p = 0.015), a smaller angle being registered in case of patent anastomosis.**



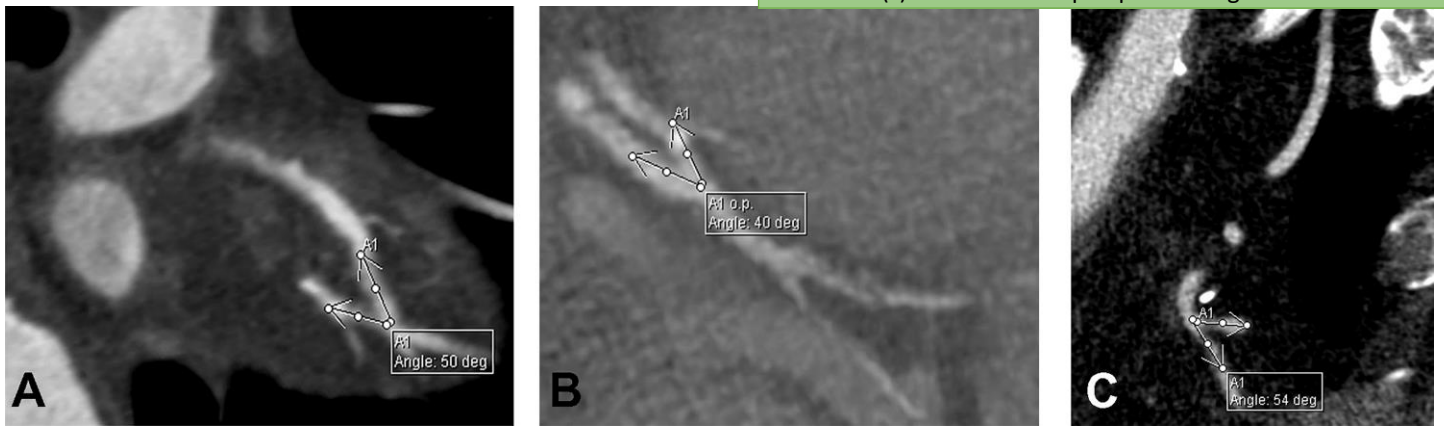
Results

- **Anastomosis angle in distal sequential grafting:**
  - **48.60º for patent vs. 53.97º for occluded side-to-side anastomoses,**
  - **65.12º for patent vs. 90.80º for occluded end-to-side anastomoses, irrespective to graft type.**
- **Anastomosis angle in single end-to-side:**
  - **arterial grafts sensitive to the anastomosis angle with a mean value of 39.46º for patent grafts and 44.94º for occluded ones (p = 0.034);**
  - **venous grafts - non-significant difference;** and registered higher patency rates in sequential designs
  - **AUC - cut-off angle 60º for an occlusion OR of 5.149 for arterial grafts in case of distal anastomosis angle ≥60º (p<0.001).**

Prognostic value of distal anastomosis angle

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Angle	1.639	.444	13.630	1	.000	5.149	2.157	12.292
	Constant	-2.367	.302	61.476	1	.000	.094		

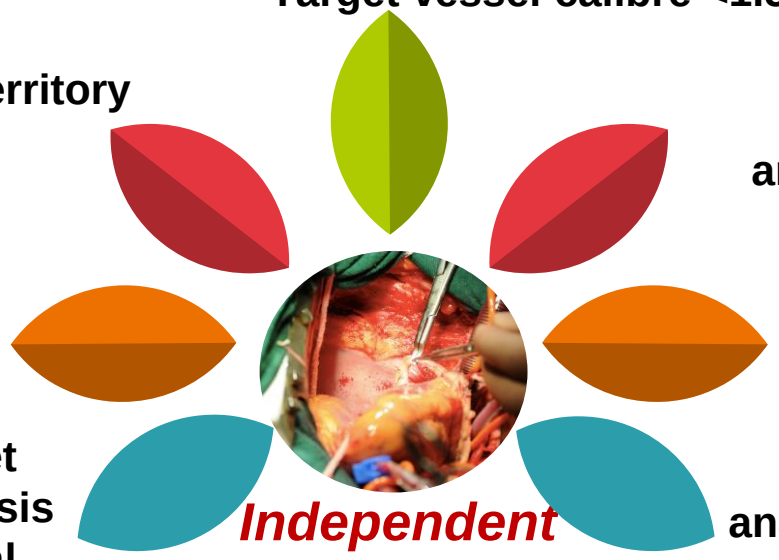
a. Variable(s) entered on step 1: paliere unghi.



Measurement of distal side-to-side (A), distal end-to-side (B), and Y (C) anastomosis angle

Discussions

Patent grafts longer than occluded ones.
Graft tension and kinking avoided.



Independent predictors of graft dysfunction

- a ***larger graft-to-host diameter ratios*** (5:3) - better hemodynamic than smaller ones (1:1) → uniform and large WSS, small WSSG;
- smaller grafts typically - risk of early graft failure due to thrombosis.

AIM - optimal patency-enhancing CABG anastomotic configuration

Hemodynamic factors:
- **Wall shear stress (WSS),**
- **WSS spatial+temporal gradients,**
- **Oscillatory shear index (OSI).**

ALTERATION IH → Graft dysfunction

How to decide?
Our decisions:
- **Young patients + diffuse CAD – TAR;**
- **Elderly patients (>70-80 yrs) – more SVGs;**
- **Target vessel degree of stenosis (70% - 90%);**
- **Co-morbidities (COPD, DM, PVD, RD ...);**
- **Surgeon's experience;**
- **Operative team (simultaneous harvesting);**
- **Adequate Number of Anastomoses (Ø>1.5mm);**
- **Type of anastomoses (Y/T/Π/ Ψ);**
- **Designed the graft arhitecture for each patient.**

In our opinion, an optimal CABG design should include a graft adapted to target vessel territory and degree of stenosis, with distal anastomosis angle under 60º, Y anastomosis angle under 56º, and a good caliber match.
The most significant factors in graft patency is flawless surgical technique in order to tailor a *patient-specific designs*.

Conclusions

- **Occlusion rate was higher in <1.5 mm target vessels calibre for both arterial and SVG grafts;**
- **RA grafts registered higher patency rates when anastomosed to the ascending aorta compared with composite grafting with LITA,**
- **A small anastomosis angle, both for proximal Y and distal anastomoses was associated with higher long-term patency of the free arterial graft;**
- **Long term graft patency correlates directly with patient specific anastomosis design;**
- **In situ RITA anastomosed to the right coronary territory is associated with a lower patency rate compared with free RITA used to revascularise the anterolateral or CX territory as part of composite grafting.**
- **Long grafts in taller patients register higher patency rates compared to short grafts in shorter patients; a small length reserve (smooth curvatures) is required to ensure free-of-tension graft;**

The current study - prove *in situ* the effect of distal anastomosis angle on graft patency and represents a potential start point for multi-institutional research.

Tinica et al. Long-term graft patency after CABGAnatol J Cardiol 2018; 20: 275-82

Long-term graft patency after coronary artery bypass grafting: Effects of surgical technique

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Received May 26, 2018; Accepted October 11, 2018

DOI: 10.3892/etm.2018.6929

Abstract. The aim of the current study was to identify surgical factors associated with long-term patency of grafts used in coronary artery bypass grafting (CABG). The present study analyzed data from 127 patients who underwent CABG at our institute between 2000 and 2006 and presented for ambulatory examination and coronary computed tomography angiography evaluation of graft patency in 2016 (139.78±36.64 months post-CABG). The 127 patients received 340 grafts (2.68 grafts/patient) and 399 distal anastomoses (3.14 anastomoses/patient), 220 (55.14%) with arterial grafts and 179 (44.86%) with saphenous vein grafts. Graft patency varied according to coronary territory, proximal anastomosis type (*in situ* graft, composite graft, graft anastomosed to the ascending aorta), Y anastomosis angle (47.21° for patent arterial grafts vs. 56° for occluded), and distal anastomosis angle (in sequential anastomoses irrespective to graft type, 48.60° for patent side-to-side anastomosis vs. 53.97° for occluded, 65.12° for patent end-to-side anastomosis vs. 90.80° for occluded; in single end-to-side anastomosis of arterial grafts, 39.46° for patent and 44.94° for occluded). A single end-to-side a higher long-term patency of the free graft. Radial artery grafts registered higher patency rates when anastomosed to the ascending aorta compared with composite grafting with the left internal thoracic artery, whereas *in situ* right internal thoracic artery (RITA) anastomosed to the right coronary territory is associated with a lower patency rate compared with free RITA used to revascularise the anterolateral or circumflex territory in composite grafting.

Introduction

In the present, cardiovascular diseases are the leading cause of death worldwide, with an estimated 17,7 million deaths per year of which 7.4 million are attributed to coronary artery disease (CAD) alone (1). Between 18 and 91 per 100,000 inhabitants benefit from coronary artery bypass grafting (CABG) in Europe (2) and, according to both European (3) and American (4) Societies' guidelines, CABG is associated with an increase in quality of life and survival in patients with unprotected left main (or equivalent) and multi-vessel disease; however, the ideal grafting technique

Long-term graft patency after coronary artery bypass grafting: Effects of morphological and pathophysiological factors

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ABSTRACT

Objective: The aim of the present study was to identify morphological and pathophysiological factors associated with long-term patency of grafts used in coronary artery bypass grafting (CABG).
Methods: A total of 127 patients who underwent CABG between 2000 and 2006 and presented for computed tomography evaluation of graft patency at 139.78±36.64 months post-CABG were analyzed. Patients received 340 grafts (2.68 grafts/patient), 399 distal anastomoses (3.14 anastomoses/patient), 220 (55.14%) performed using arterial grafts, and 179 (44.86%) using saphenous vein grafts (SVGs).
Results: Graft patency varied according to vessel type and coronary territory. Overall graft patency was 90.16% for the left internal thoracic artery (LITA), 75.55% for the right internal thoracic artery (RITA), 79.25% for the radial artery (RA), and 74.3% for the SVG. The maximum patency rate was obtained with the RA (80.65%) for the right coronary territory, RITA (92.86%) for the anterolateral territory, and SVG (82.54%) for the circumflex territory. The LITA–left anterior descending artery graft occluded in 13 (7.93%) cases, 7 due to competitive flow. The influence of graft length on patency rates after indexing to height was not significant. The target vessel degree of stenosis influenced arterial graft patency rates with an occlusion odds ratio (OR) of 3.02 when anastomosed to target vessels with <90% stenosis. Target vessel caliber also influenced patency rates with occlusion ORs of 2.63 for SVGs and 2.31 for arterial grafts when anastomosed to ≤1.5 mm target vessels.
Conclusion: Morphological parameters, such as graft type, target territory, target vessel caliber, and degree of stenosis, are important factors conditioning long-term graft patency. *(Anatol J Cardiol 2018; 20: 275-82)*
Keywords: coronary artery bypass grafting, long-term patency, morphological factors, pathophysiological factors

Introduction

Coronary artery bypass grafting (CABG) is nowadays one of the most frequent surgical interventions in Europe (between 18 and 91/100,000 inhabitants) (1). According to both European

Early CABG interventions were performed almost entirely using aorta-to-coronary saphenous vein grafts (SVGs), but angiographic follow-up studies revealed a late attrition rate of 2%–5% per year after surgery related to intrinsic pathological changes in grafts (4, 5). Despite their anatomical imperfection, venous

Muchas Gracias!

Thank you!

Muito Obrigado!

Mulțumesc!