

Total Arterial Grafts in Coronary Bypass: A Comparative Study after Five Years Outcome

Nurul Aqilah^{1*}, Abu Yamin¹, Abdul Muhaimin¹, Mohd Taufik¹, Phong Fu Hong¹, Mohd Khairul Aziz¹

¹Cardiothoracic Surgery Department, Hospital Pulau Pinang, Pulau Pinang, Malaysia

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*Corresponding author: Nurul Aqilah

Cardiothoracic Surgery Department, Hospital Pulau Pinang, Pulau Pinang, Malaysia

Abstract

Original Research Article

Purpose of Study: The conduits of choice for coronary revascularization in coronary artery bypass grafting (CABG) is an ongoing discussion among surgical practitioners. The paradigm shift in current studies is inclining towards the approach of total arterial grafting (TAG) as superior in long term outcomes when compared to multiple arterial grafts (MAG) or single arterial grafts (SAG) with vein grafting. However, TAG has not become the standard of care till present-day. In this study, we assessed the major adverse cardiac events (MACE), New York Heart Association Classification (NYHA) and Canadian Cardiovascular Society (CCS) classification as composite endpoint of TAG versus non-TAG post five years CABG. **Methods:** A retrospective cohort study is designed to evaluate the outcomes of TAG when compared to non-TAG approaches in patients who underwent CABG in Hospital Pulau Pinang (HPP) between 2015 to 2017. A total of 44 (11 TAG and 33 non-TAG) patients are enrolled in the study with comparable preoperative variables. The mean age is 53.6 ± 5.43 years, with the age range 41 – 60 years. All participants are from gender male with comorbidities of diabetes mellitus, hypertension and dyslipidemia. Operative technique of median sternotomy with either on pump or off pump CABG is employed in both TAG and non-TAG group. The conduits of choice in this study are combinations of bilateral internal mammary artery (BIMA), left internal mammary artery (LIMA), and radial artery (RA) for TAG group with concomitant use of saphenous vein (SV) in non-TAG group. Univariate analysis and comparison between the two clinical groups are performed. **Results:** Patients were followed up to assess the clinical outcome following CABG. TAG reported better NYHA symptoms control ($p=0.04$) with no statistically significance difference between both groups in CCS classification and MACE incidence. It is essential to note the statistical limitation due to small sample size available for study. **Conclusion:** Total arterial grafting (TAG) is superior in terms of symptom control (NYHA) in long term clinical outcome, however both groups are non-inferior to each other on other aspects. **Keywords:** Total Arterial Grafting (TAG), Coronary Artery Bypass Grafting (CABG), Major Adverse Cardiac Events (MACE), New York Heart Association (NYHA).

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INTRODUCTION

Coronary artery bypass grafting (CABG) holds a large annual volume of most commonly performed cardiac surgery procedure worldwide. In our centre approximately 357 cases of CABG performed yearly on average from the past years. Hence, the debate on factors that can improved survival outcomes unto patient undergoing CABG implies a significant weightage among cardiothoracic surgeons. One which being the conduits of choice to ensure long term patency, thus contributed to longer survival outcomes.

The history of using arterial vessel as conduit of choice in performing CABG, dated back in 1961 on 'Internal Mammary- Coronary Artery Anastomosis: A Nonsuture Method Employing Tantalum Rings'

published by the journal of Thoracic and Cardiovascular Surgery. Subsequently, multiple studies in 1967-1984 published on the questionable patency of saphenous vein as conduits of choice for CABG with The New England Journal of Medicine publishing a study of 10years aortocoronary bypass surgery using saphenous vein as conduits where 62% shows evidence of occlusion. This ongoing debate continues with the discussion from systematic review with meta-analysis showing total arterial CABG associated with better long-term survival published by Brazilian Cardiovascular Journal in 2021.

Thus, the paradigm shift in current studies is inclining towards the approach of total arterial grafting (TAG) as superior in long term outcomes when compared to multiple arterial grafts (MAG) or single arterial grafts (SAG) with vein grafting. However, TAG

has not become the standard of care till present-day. In this study, we assessed the major adverse cardiac events (MACE), New York Heart Association Classification (NYHA) and Canadian Cardiovascular Society (CCS) classification as composite endpoint of TAG versus non-TAG post five years CABG.

METHODS

A retrospective cohort study is designed to evaluate the outcomes of TAG when compared to non-TAG approaches in patients who underwent CABG in Hospital Pulau Pinang between 2015 to 2017 with their 5years outcomes. The outcomes are studied based on; 1) major adverse cardiac events (MACE) which includes; stroke, cardiac death, cardiovascular event requiring

emergency department visit with or without admission, and need of coronary revascularization, 2) New York Heart Association Classification (NYHA) and 3) Canadian Cardiovascular Society (CCS) classification.

Inclusion Criteria

- 1) Male
- 2) Less than 60years old
- 3) Same comorbidities: DM/Hypertension/Dyslipidemia
- 4) At least 2 vessels disease
- 5) Median sternotomy
- 6) EF>45%
- 7) Single Procedure
- 8) Same surgeon

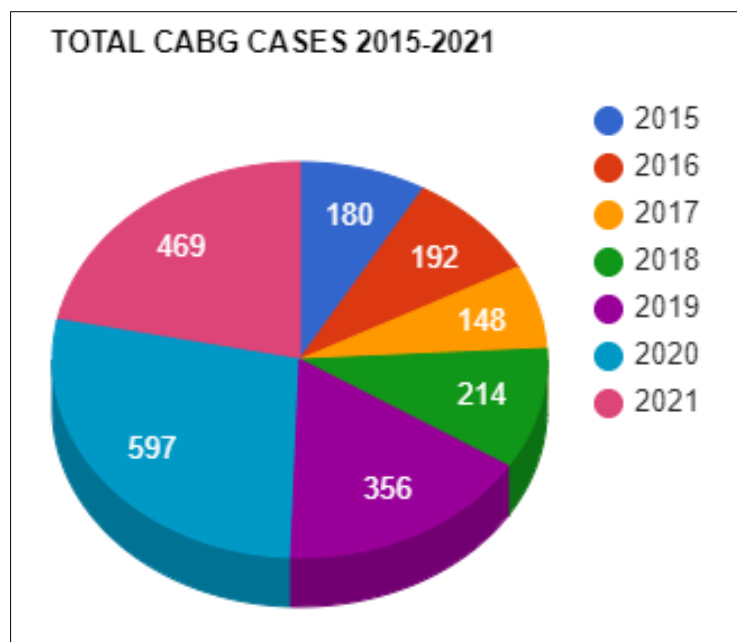


Figure 1: Total CABG Cases in HPP 2015-2021

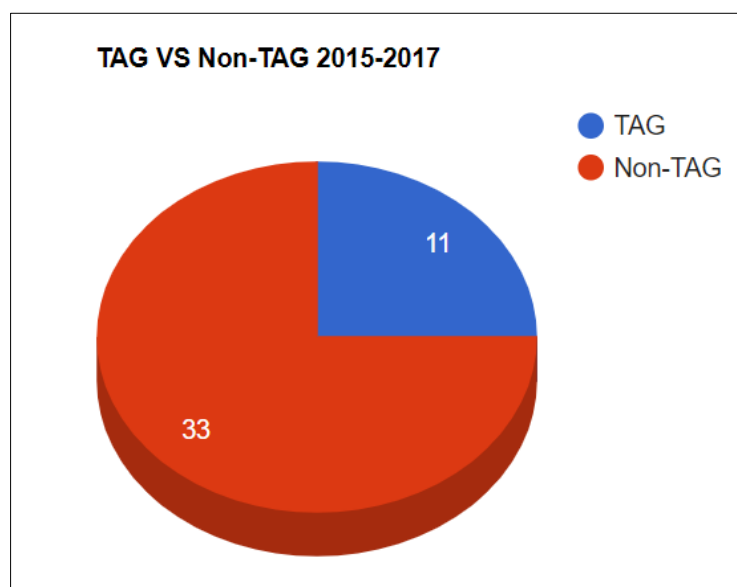


Figure 2: Numbers of CABG Cases TAG Vs NTAG 2015-2017 in HPP

VARIABLE	TAG (n=11)	NTAG (n=33)
Age, (SD)	52.42 ($\pm$ 5.79)	54.00 ($\pm$ 4.68)
Male	11 (1.0)	33 (1.0)
Smoker	7(0.64)	20 (0.60)
Hypertension	8 (0.72)	30(0.81)
Diabetes Mellitus	4 (0.36)	5 (0.15)
Dyslipidaemia	9 (0.82)	29 (0.85)
H/O MI	4(0.36)	10(0.30)
Previous PCI	1(0.09)	3(0.09)
2-Vessel Disease	2 (0.18)	2(0.06)
3-Vessel Disease	9 (0.82)	31(0.93)
LMS involvement	6(0.55)	16(0.48)
LVEF, %		
45-49	1 (0.09)	4 (0.12)
> 50	10 (0.9)	29 (0.87)

Figure 3: Variable Criteria of CABG patients in HPP 2015-2017 between TAG vs NTAG

Configuration	TAG	Non-TAG
LIMA to - LAD - Diagonal - LCX	9 (0.8) 2 (0.18)	33 (1.0) 6 (0.18)
RIMA to - LAD - PDA - RCA	1 (0.09) 1 (0.09) 3 (0.27)	- - 2 (0.06)
RA to - LCX - OM - Intermediate - Diagonal - PDA - PLV	4(0.36) 4 (0.36) 2 (0.18) 1 (0.09) 2 (0.18)	2 (0.06) 13 (0.39) 5 (0.15) 3 (0.09) 2 (0.06) 1(0.03)
SVG - PDA - OM - PLV - LCX - Diagonal - RCA - Intermediate	- - - - - - -	19 (0.58) 10 (0.3) 6 (0.18) 3 (0.09) 12 (0.36) 3 (0.09) 6 (0.18)

Figure 4: Conduits and Grafts Configuration between TAG VS NTAG from 2015-2017 in CABG patients in HPP

Conduits	TAG	Non-TAG
LIMA+RA	5 (0.45)	-
BIMA	2 (0.18)	-
BIMA+RA	4(0.36)	-
LIMA+RA+SVG	-	24(0.73)
LIMA+SVG	-	7(0.21)
BIMA+SVG	-	2(0.06)
CABG (n)	11	33
• X2	2(0.18)	-
• X3	5(0.45)	8(0.24)
• X4	3(0.27)	18(0.55)
• X5	1(0.09)	7(0.21)
OFF Pump	2(0.18)	5(0.15)

Figure 5: Conduits Summary between TAG VS NTAG from 2015-2017 in CABG patients in HPP

RESULTS

Patients were followed up through history taking and clinical documentations available to assess the clinical outcome following CABG. In terms of MACE outcomes, 1 MACE reported in TAG group (9%)

while 3 MACE reported in NTAG group (9%). TAG reported better NYHA symptoms control ($U=109$), ($z:1.68$), ($p=0.04$) with no statistically significance difference between both groups in CCS classification and MACE incidence. It is essential to note the statistical limitation due to small sample size available for study.

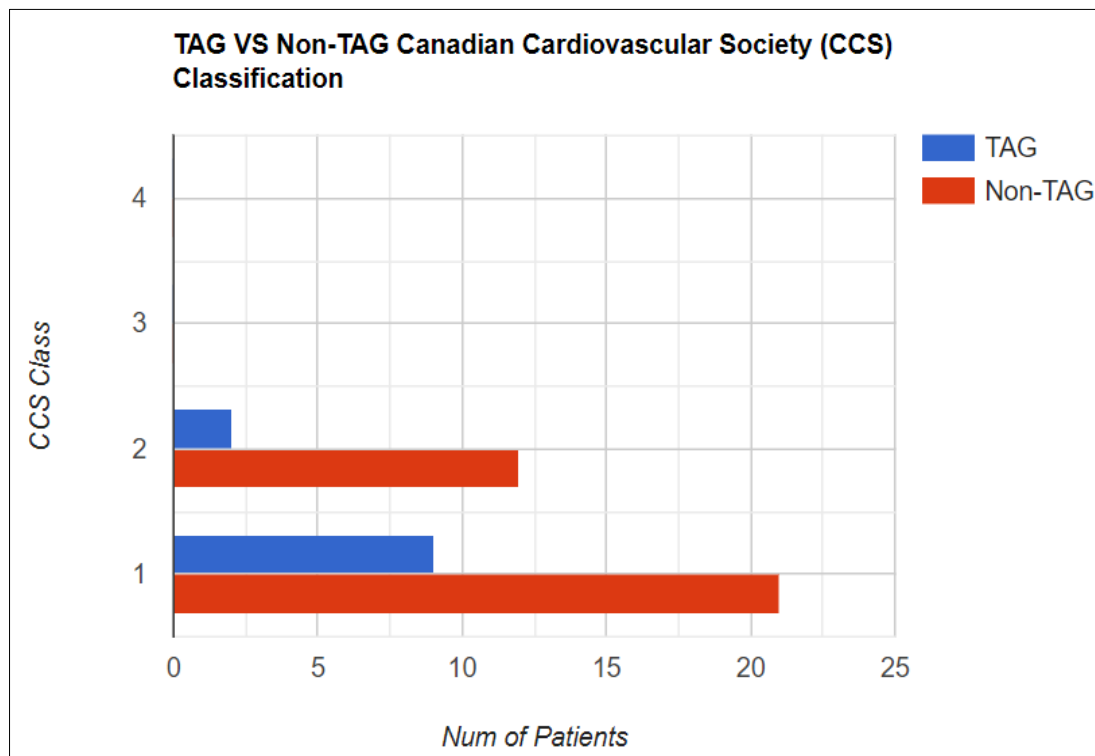


Figure 6: CCS Outcomes in CABG patients in HPP 2015-2017

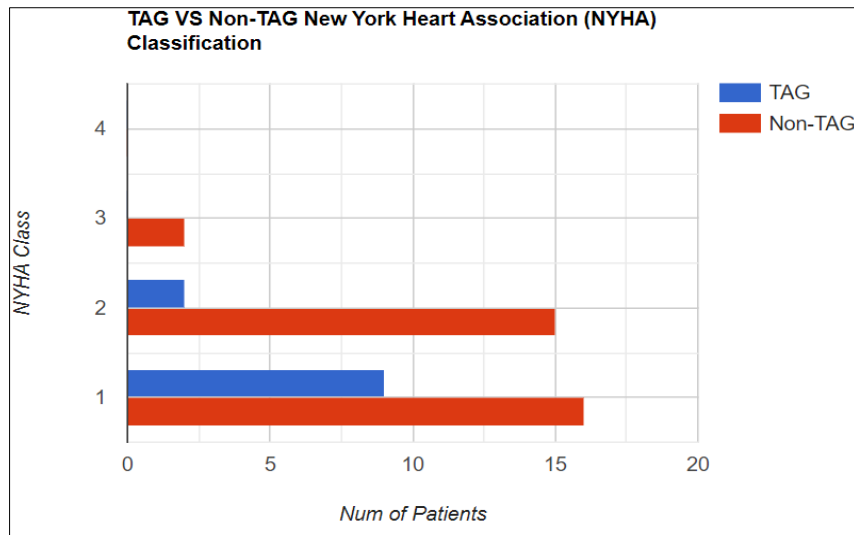


Figure 7: NYHA Outcomes in CABG patients in HPP 2015-2017

DISCUSSION

CABG remains the gold standard treatment for multi-vessel coronary artery disease, particularly in triple vessels disease with left main coronary artery involvements which evidence by providing longer duration of survival outcomes with minimal adverse complications post procedure.

Choice of conduits between arterial and venous rooted from the debate to provide longer patency to prevent the need of revascularization in the future. Patency not only affected by conduits selection, but also by methods of harvesting and suitability of conduits selection based on degree of coronary stenosis to prevent competitive flows.

Multiple guidelines being established following multiple meta-analysis and systematic reviews done worldwide. As per European Association for Cardiothoracic Surgery 2021 Guidelines, arterial grafting with internal mammary artery (IMA) to the left anterior descending system is recommended and the use of radial artery is preferred over saphenous vein in patients with high grade coronary artery stenosis with both at level 1B evidence. Left IMA shows 95% patency in 10years (FD Loop) while radial artery shows 89% patency in 10 years (Gianmarco Cancelli). Methods of harvesting via skeletonized technique for IMA is also recommended with level 1B evidence.

Despite all these recommendations, it's important to note that the risk of deep sternal wound infection with BIMA harvesting is proven to be higher especially in diabetes mellitus patients. BIMA only considered in patients that do not have a high risk of sternal wound infection (level II a). The tendencies for vasospasm in radial artery is also higher as per compared to saphenous veins.

Thus, multiple considerations should be made selectively on every CABG candidate patients in order to provide better long-term outcomes.

CONCLUSION

In our centre, total arterial grafting (TAG) is superior in terms of symptom control (NYHA) in long term clinical outcome, however both groups are non-inferior to each other on other aspects. However, further studies with larger sample size should be considered for more depth on TAG outcomes analysis as it holds a significant direction of CABG surgical approach in the future.

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