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Outcome of Total Arterial Coronary Artery Bypass Grafting: Our Initial experience

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ABSTRACT

Introduction: Total arterial coronary artery bypass grafting has better outcome than the conventional operative technique, in which vein grafts are also used.

Objective: The objective of the study was to describe the patient demographics, coronary artery involvement, arterial conduit used and early outcome of patients undergoing total arterial coronary artery bypass grafting.

Methods: A retrospective, descriptive study was conducted at the Manmohan Cardiothoracic Vascular and Transplant Centre, Institute of Medicine, Kathmandu, Nepal, including all the patients who underwent total arterial coronary artery bypass grafting from November, 2023 to November 2024. Hospital medical records were used to review the demographics, perioperative variables and outcome parameters. Descriptive statistics was used to analyze the data.

Results: Twenty patients underwent total arterial coronary artery bypass grafting. The mean age of the patients was 50.20 ± 11.76 years. Males were more commonly affected. Ten (50%) patients had double vessel disease. Hypertension was seen in 10 (50%) patients. Aortic cross clamp time was 51.22 ± 26.81 minutes and cardiopulmonary bypass time was 81.75 ± 26.93 minutes. Left internal mammary artery and radial artery were used in 11(55%) patients, bilateral mammary and radial arteries were used in 5(25%) patients. The mean duration of stay in intensive care unit and hospital stay were 4.85± 3.70 and 11.90 ± 6.63 days, respectively. There were two mortalities due to ventricular fibrillation.

Conclusion: Total arterial coronary artery bypass grafting seems feasible and safe in our setting. But a larger comparative study is essential to infer the findings statistically.

Keywords: Coronary artery disease; Coronary artery bypass grafting; internal mammary artery; radial artery.

INTRODUCTION

Atherosclerotic Coronary artery disease (CAD) causing adverse cardiovascular events like myocardial infarction, heart failure and stroke, claims millions of lives worldwide.[1]

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Coronary artery bypass grafting (CABG) is one of the most commonly performed surgical operations worldwide.[2] The grafts used in CABG include left internal mammary artery (LIMA) and segments of great saphenous vein (GSV). Graft failure negates the benefits of CABG and leads to recurrent angina, poor survival, and need for re-vascularization.[3] Arterial Revascularization Trial demonstrated that, total arterial revascularization has the lowest mortality rate.[4] The superiority of LIMA over SVG to revascularize diseased left anterior descending artery (LAD) is well established.[5] A good outcome has been seen with the use of Bilateral internal mammary artery (BIMA)

grafts and radial artery (RA) grafts as compared to the use of SVG.[6,7] This surgical approach has been used in Nepal infrequently in cardiac centers around the country. However, there are not any studies conducted in Nepal looking at the outcome of this procedure. Since, this approach has recently been introduced in our hospital and our department is performing this procedure, as a routine practice since last year, this study is intended to study demographics, early postoperative outcome of CABG with total arterial grafts in our center.

METHODS

This was a retrospective, single-center descriptive study conducted at the Manmohan Cardiothoracic Vascular and Transplant Centre (MCVTC), Institute of Medicine, Kathmandu, in order to investigate the outcome of total arterial coronary artery bypass grafting (TA-CABG) in adult patients. A convenience, inclusive sampling technique was used and all the twenty patients who underwent TA-CABG from November, 2023 to November 2024 were included in the study. Data were extracted from the hospital medical records and following variables were studied: age, gender, cardiac diagnosis, left ventricular ejection fraction, the types of arteries used, size of the artery used, cardiopulmonary bypass time, aortic cross-clamp time, length of ICU and hospital stay, postoperative complications, wound infection and mortality. Descriptive statistics was used to analyze the data. The need for informed consent was waived due to the retrospective nature of the study. Confidentiality was achieved by de-identifying the patient's data. Statistical Package for the Social Sciences version 22.0 was used to perform the statistical analysis.

Among 700 cardiac surgeries, 20 patients underwent TA-CABG in twelve months (November, 2023 to November, 2024) at MCVTC. The mean age of the patients was 50.20 ± 11.76 years (range 18- 70 years). Eight patients were in 50-59 years age group. Only one patient was eighteen years old; however, he did not have a coronary artery disease. The patient was diagnosed to have a right coronary artery aneurysm intraoperatively, for which, the patient underwent excision of the aneurysmal artery with single vessel coronary artery bypass grafting to right coronary artery using right internal mammary artery. The majority of the patients were males, with a male to female ratio of 4:1.

RESULTS

Majority of the patients had double vessel disease (Table 1). The mean duration of symptoms was 194.25± 120.17 days. The main presenting symptoms were angina on exertion, shortness of breath, palpitation. All of them had a normal left ventricular ejection fraction. One patient had a rheumatic mitral regurgitation. All the patients had sinus rhythm. None of the patients had a prior percutaneous coronary intervention.

Table 1:Preoperative Variables.

Variables	Category	N (%)
Gender	Males	16 (80)
	Females	4 (20)
Age group in years	Less than 20	1 (5)
	20-29	0
	30-39	2 (10)
	40-49	5 (25)
	50-59	8 (40)
	60-69	3 (15)
	70-79	1 (5)
Coronary artery disease	Single Vessel Disease	3 (15)
	Double Vessel Disease	10 (50)
	Triple Vessel Disease	7 (35)
Valvular dysfunction	None	19 (95)
	Mitral Regurgitation	1 (5)
Diabetes	Yes	6 (30)
	No	14 (70)
Hypertension	Yes	10 (50)
	No	10 (50)
Smoking	Yes	4 (20)
	No	16 (80)

Aortic cross clamp time was 51.22 ± 26.81 minutes and cardiopulmonary bypass time was 81.75 ± 26.93 minutes. Adjunct procedure performed included Mitral Valve replacement in one patient. Majority of the patients underwent surgery with the use of cardiopulmonary bypass and without arresting the heart (Table 2).

Table 2: Intra-operative variables

Variables	Category	N (%)
Use of Cardiopulmonary Bypass	On Pump-Beating heart	3 (15)
	On Pump-Arrested heart	9 (45)
	Off Pump	8 (40)
State of the heart during anastomosis	Beating	11 (55)
	Arrested	9 (45)
Arterial grafts	LIMA	2 (10)
	RIMA	2 (10)
	LIMA, RIMA, RA	5 (25)
	LIMA, RA	11 (55)
Anastomosis	LIMA to LAD	18 (90)
	RIMA to RCA	4 (20)
	RIMA to PDA	1 (5)
	RIMA to PLV	1 (5)
	RIMA to OM1	1 (5)
	RA to OM1	8 (40)
	RA to OM2	1 (5)
	RA to OM3	1 (5)
	RA to PDA	3 (15)
	RA to RCA	1 (5)
	RA to D1	1 (5)
	RA to RI	1 (5)

LIMA-Left internal mammary artery, RIMA-Right internal mammary artery, RA-Radial artery, LAD-Left anterior descending artery, RCA-Right coronary artery, PDA-Posterior descending artery, PLV-Posterior left ventricular, OM1-first obtuse marginal, OM2-secoond obtuse marginal, OM3-third obtuse marginal, D1-first diagonal, RI-ramus intermedius

Eighteen patients were extubated within 24 hours of surgery. The mean mediastinal drainage 296.84 ±161.87ml in first 24 hour (Table 3). None of the cases required re-exploration. None of the patient had renal impairment, arrhythmia causing significant hemodynamic instability. There were two perioperative mortalities. Both the patients were 65-year-old male with double vessel disease, who underwent off-pump CABG. One patient had left internal mammary artery anastomosed to left anterior descending artery and radial artery anastomosed to ramus intermedius, whereas the second patient had left internal mammary artery anastomosed to left anterior descending artery and radial artery anastomosed to right coronary artery. Both of them had intractable ventricular fibrillation.

None of the other eighteen patients had renal impairment, arrhythmia causing significant hemodynamic instability, stroke and wound infection.

Table 3: Post-operative variable.

Variables	Value (Mean ± SD)
Mediastinal bleeding in first 24 hour (ml)	296.84 ± 161.87
Intensive Care Unit stay (days)	4.85± 3.70
Hospital stay (days)	11.90 ± 6.63

DISCUSSION

Low middle income countries have higher incidence of CAD and morbidity and mortality due to CAD. The incidence of heart disease is 7.1 per 1000 person years in low-income countries is 6.8 per 1000 person years in middle income countries is and 4.1per 1000 person years in high income countries.[8,9] Cardiovascular disease is responsible for 43% of deaths in low-income countries ,41% in middle income countries and 23% in high income countries.[8] In 2017, cardiovascular disease contributed to 26.9% of total deaths out of which CAD contributed to 16.4% of total deaths. In Nepal the trend is such that the cardiovascular disease incidence and mortality rates have increased from 1990 to 2017, significantly affecting males and older age population. [10]

Although percutaneous coronary intervention (PCI), or coronary angioplasty, is a widely accepted treatment in less severe diseases, CABG is a superior treatment option for myocardial revascularization.[11,12] Total arterial CABG offers an improved short term and long-term survival, patency of the graft, preservation of heart function and symptoms free period. Majority of the patients coming to our center with CAD are middle aged adults. In this study also, most of the patients were fifty years and more. A male preponderance was observed in our study. Similar results were seen in a study by Lin et. al, in which they found that the median age was 56 years and 60.7% of their patients were males.[13]

Hypertension and diabetes were commonly associated comorbidities in our patients. The most commonly used arterial conduit in our study was LIMA, followed by RA and RIMA. In most of the studies, the combination of these arteries was used for TA-CABG.[14] Other arteries like gastro-epiploic artery, inferior epigastric artery, splenic artery and ulnar artery are not popular for TA-CABG. The arterial grafts can be used as pedicled or free grafts. Only one RIMA graft was used as a free graft, whereas all other RIMA and LIMA grafts were used as pedicled grafts in our study. We also performed off-pump beating heart and On-pump beating heart CABG.

Most of our patients had double and triple vessel disease. Majority of the patients received more than two grafts and were completely revascularized. Since two surgeons were working together, the time taken for harvesting the conduits ranged from thirty minutes to forty-five minutes depending on the need of harvesting RIMA. RA was harvested from the

left upper limb after confirmation of the complete palmar vascular arch. Despite harvesting both the mammary arteries, sternal infection was not seen. None of the patient complained of paresthesia or weakness of left upper limb after harvesting RA. The intensive care unit and hospital stays in our study were 4.85± 3.70 and 11.90 ± 6.63, these were similar to other study.[13]

The small sample size studied retrospectively is the limitation of our study. With larger number of cases undergoing surgery with this technique, long term follow-up study will give a clearer picture of the outcome in our setting. We have also not compared this operative technique with the conventional CABG where vein grafts are also used. A comparative study of these two approaches with larger number patients, over a longer period of time is essential to generalize our finding.

CONCLUSION

Total arterial CABG is feasible in our setting with minimal morbidity, short stay in intensive care unit and hospital. This approach should be more frequently performed in cardiac centers. Intermediate and long- term follow up of these patients are yet to be done, to assess the long-term benefits of the approach, symptomatic status, recurrent hospital admissions and re-intervention.

Conflict of Interest: None.

REFERENCES

1. Lavoie L, Khoury H, Welner S, Briere JB. Burden and Prevention of Adverse Cardiac Events in Patients with Concomitant Chronic Heart Failure and Coronary Artery Disease: A Literature Review. Cardiovasc Ther. 2016 Jun;34(3):152-60. [PubMed | Full Text | DOI]
2. Serruys PW, Morice MC, Kappetein AP, Colombo A, Holmes DR, Mack MJ, et al. SYNTAX Investigators. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. N Engl J Med. 2009 Mar 5;360(10):961-72. [PubMed | Full Text | DOI]
3. Lopes RD, Mehta RH, Hafley GE, Williams JB, Mack MJ, Peterson ED, et al. Project of Ex Vivo Vein Graft Engineering via Transfection IV (PREVENT IV) Investigators. Relationship between vein graft failure and subsequent clinical outcomes after coronary artery bypass surgery. Circulation. 2012 Feb 14;125(6):749-56 [PubMed | Full Text | DOI]
4. Taggart DP, Gaudino MF, Gerry S, Gray A, Lees B, Dimagli A, et al. Effect of total arterial grafting in the Arterial Revascularization Trial. J Thorac Cardiovasc Surg. 2022 Mar;163(3):1002-1009.e6. doi: 10.1016/j.jtcvs.2020.03.013. Epub 2020 Mar 19. PMID: 32305186. [PubMed | Full Text | DOI]
5. Windecker S, Kolh P, Alfonso F, Collet JP, Cremer J, Falk V, et al. 2014 ESC/EACTS Guidelines on myocardial revascularization: The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)Developed with the special contribution of the European Association of Percutaneous Cardiovascular Interventions (EAPCI). Eur Heart J. 2014 Oct 1;35(37):2541-619. [PubMed | Full Text | DOI]
6. Gaudino M, Benedetto U, Fremes S, Biondi-Zoccai G, Sedrakyan A, Puskas JD, et al. Radial-Artery or Saphenous-Vein Grafts in Coronary-Artery Bypass Surgery. N Engl J Med. 2018 May 31;378(22):2069-77. [PubMed | Full Text | DOI]
7. Benedetto U, Raja SG, Albanese A, Amrani M, Biondi-Zoccai G, Frati G. Searching for the second best graft for coronary artery bypass surgery: a network meta-analysis of randomized controlled trials†. Eur J Cardiothorac Surg. 2015 Jan;47(1):59-65; discussion 65. [PubMed | Full Text | DOI]

8. Dagenais GR, Leong DP, Rangarajan S, Lanas F, Lopez-Jaramillo P, Gupta R, et al. Variations in common diseases, hospital admissions, and deaths in middle-aged adults in 21 countries from five continents (PURE): a prospective cohort study. Lancet. 2020 Mar 7;395(10226):785-94. [PubMed | Full Text | DOI]
9. Yusuf S, Joseph P, Rangarajan S, Islam S, Mente A, Hystad P, et al. Modifiable risk factors, cardiovascular disease, and mortality in 155 722 individuals from 21 high-income, middle-income, and low-income countries (PURE): a prospective cohort study. Lancet. 2020 Mar 7;395(10226):795-80. [PubMed | Full Text | DOI]
10. Bhattarai S, Aryal A, Pyakurel M, Bajracharya S, Baral P, Citrin D, et al. Cardiovascular disease trends in Nepal - An analysis of global burden of disease data 2017. Int J Cardiol Heart Vasc. 2020 Jul 31;30:100602. [PubMed | Full Text | DOI]
11. Mohr FW, Morice MC, Kappetein AP, Feldman TE, Ståhle E, Colombo A, et al. Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the randomised, clinical SYNTAX trial. Lancet. 2013 Feb 23;381(9867):629-38. [PubMed | Full Text | DOI]
12. Cao C, Manganas C, Bannon P, Vallely M, Yan TD. Drug-eluting stents versus coronary artery bypass graft surgery in left main coronary artery disease: a meta-analysis of early outcomes from randomized and nonrandomized studies. J Thorac Cardiovasc Surg. 2013 Mar;145(3):738-47. [PubMed | Full Text | DOI]
13. Lin Zq, Xu Z, Chen Lw, Dai Xf. Short-Term Outcomes of Total Arterial Revascularization Compared to Conventional Coronary Artery Bypass Graft in Patients with Multivessel Disease and Left Ventricular Dysfunction, J Card Surg. 2023, 5557796. [Full Text | DOI]
14. Dominici C, Chello M, Saeed S. Outcomes of total arterial revascularization vs conventional revascularization in patients undergoing coronary artery bypass graft surgery: A narrative review of major studies. Pak J Med Sci. 2022 May-Jun;38(5):1395-400. [PubMed | Full Text | DOI]