AMJ Australasian Medical Journal [AMJ 2021;14(1):29-33]

Coronary Artery Bypass grafting (CABG) versus Percutaneous Coronary Intervention (PCI) in the treatment of multivessel coronary disease: A review

Ahmed Ebrahim Al Ansari[1], Hassan Ali Alzahrani[1], Waad Maher Alqulayti[1], Maram Adnan Rawah[1], Leena Lotfy Alnajjar[1], Alaa Tarek M Subedar[1], Banan Matuq M Aloufi[1], Ibrahim Mahmoud H Ajwah[1], Abdulaziz Abdullah M Albalawi[2], Khalid Mohammed A Aljohani[2], Abdulrahman Mohammed K Albalawi[2], Shahad Saad A Aljoaid[2], Raya Abdullah S Alatawi[2], Afnan Saleh M Alsaiari[2], Lamia Mohammed S Alrefai[2], Abdulrahman Muneer H Hameed[3], Dalal Khalid H Al Masoud[4], Ali Mohamed S Alsada[5]

1. Saudi Commission for Health Specialties, Saudi Arabia
2. University of Tabuk, Saudi Arabia
3. Ibn-Sina college, Jeddah, Saudi Arabia
4. Taibah University, Saudi Arabia
5. Salmaniya Medical Complex, Bahrain

REVIEW

Please cite this paper as: Al Ansari A, Alzahrani H, Alqulayti W, Rawah M, Alnajjar L, Subedar A, Aloufi B, Ajwah I, Albalawi I, Aljohani K, Albalawi K, Aljoaid S, AlatawiR, Alsaiari A, Alrefai L, Hameed A, Al Masoud D, Alsada A. Coronary Artery Bypass grafting (CABG) versus Percutaneous Coronary Intervention (PCI) in the treatment of multivessel coronary disease: A review. AMJ 2021;14(1):29–33.
https://doi.org/10.35841/1836-1935.14.1.29-33

Corresponding Author:
Name: Ibrahim Mahmoud Ajwah
Address: King Salman Armed Forced Hospital PO Box 3458 Tabuk 51937, Saudi Arabia.
Email address: aj.wa@hotmail.com

ABSTRACT

Background

Revascularization for patients who suffer multivessel coronary artery disease is a common procedure around the world. Taking United about 700,000 patients have multivessel coronary revascularization per year ¼ of these patients are diagnosed with diabetes.

Aims

To summarize the current evidence that compare CABG to PCI in multivessel coronary disease in form of cardiac death, stroke, MI and unplanned devascularization.

Methods

This is a systematic review was carried out, including PubMed, Google Scholar, and EBSCO that examining randomized trials of treatment of multivessel coronary disease to summarize the major RCT concerning this topic.

Results

The review included five randomized studies that compare coronary artery bypass grafting and percutaneous coronary intervention. The findings showed that CABG show better result with less mortality rate.

Conclusion

This review concluded that there revascularization in treating coronary artery disease could be conducted either by CABG or PCI, CABG show better result as it cause less death, MI and revascularization rates, but the usage of new additions such as second generation DES, can also improve the safety and efficacy of PCI when added to it.

Key Words

Coronary Artery Bypass grafting (CABG), Percutaneous Coronary Intervention (PCI), treatment of multivessel coronary disease

What this study adds:

1. What is known about this subject?

CABG is the first line of treatment recommended in many cases especially in complex coronary lesions and in absence of high operative risks.

2. What new information is offered in this study?

The findings showed that CABG show better result with less mortality rate.

3. What are the implications for research, policy, or practice?

The revascularization in treating coronary artery disease could be conducted either by CABG or PCI, but the usage of new additions such as second-generation DES, can also improve the safety and efficacy of PCI when added to it.

Background

Percutaneous coronary intervention (PCI) technology has been considered for long time as the 'gold standard 'for treating multivessel stable coronary artery disease (CAD). But with time new alternatives came out such as balloon angioplasty, bare-metal stents (BMS) and subsequently drug-eluting stents (DES) due to rapid improvement in the technology. All this necessities conducting studies to compare the efficiency of the different available method and using this as an index while treating any case. While the consistent efficiency of PCI lead to increase of its usage as the main standard in treating even complex CAD.[1]

Comparing balloon angioplasty to coronary artery bypass grafting (CABG) showed that CABG had better effect on the health and patients who underwent GABG lived more than those who underwent balloon angioplasty and this was the main reason behind making CABG the recommended treatment option in diabetic patients.[2,3] Using arterial conduits and adding antithrombotic medications to the treatment regimen showed an increase in the efficiency of CABG.[4,5]

Method

A systematic electronic search was conducted including the Pub Med, Google Scholar, and EBSCO using the following terms in different combinations Coronary Artery Bypass Grafting, Percutaneous Coronary Intervention and Multivessel Coronary Disease. A full text randomized controlled trials that available in English, aimed to compare between CABG *vs.* PCI in regards to cardiac death, stroke, and myocardial infarction were included. Studies published in abstract form only were excluded. The abstracts and full texts were screened independently by two authors (AA, AH). The authors extracted the data, and then the author's names, year and region of publication, the study type, period of study, and the result were reported (Table1).

Results

The search of the mentioned databases returned a total of 74 studies that were included for title screening. 63 of them were included for abstract screening, which lead to the exclusion of 38 articles. The remaining 25 publications full-texts were reviewed. The full-text revision lead to the exclusion of zero studies, and five were enrolled for final data extraction (Table 1).[6-10]

Discussion

Coronary revascularization could be done either using coronary artery bypass grafting (CABG) or percutaneous coronary intervention (PCI) with stenting, both the primary and the secondary outcomes are discussed for each strategy, to help determining the best treatment strategy for each condition.

Farkouh et al. found that in diabetic patients with multivessel Coronary artery disease, treating the patients with CABG has less death and myocardial infarction than PCI with stent. This results were similar to angiographic and renal function results obtained using SYNTAX score.[11] Other smaller studies supported the same results about diabetic patients, a study compared balloon angioplasty to CABG showed that CABG is the best recommended and preferred strategy for treating diabetic patients with Coronary artery disease.[12,13] Then other studies revealed more side effects when using PCI as a treatment, Arterial Revascularization Therapies Study (ARTS) (historical control)[14] and SYNTAX (subgroup analysis) the main unwanted side effects were cerebrovascular and cardiovascular effects, but the most common and rapidly discovered effect was higher rate of revascularization. On the other hand, using CABG caused a significant reduction in myocardial infarction and death rates. The stroke effect was higher in CABG compared to PCI, this result was common and seen almost with every comparative study and meta-analysis.[15]

CARDia indicates the first trial conducted to study the efficacy and safety of both CABG and PCI in diabetic patients. The importance of studying this group of patients specifically is because about 80 per cent of people are having diabetes, so it is a very common disease and also most of the diabetic patients when they acquire

cardiovascular disease, they become more susceptible to death up to 80 per cent of deaths.[16,17] CABG is an effective strategy when treating diabetic patients but it still has many unwanted adverse effects such as high morbidity, staying in the hospital for longer duration and taking much time to recover when we compare it to PCI.[18,19] For the PCI group, mortality in the CARDia trial was 3.2 percent, which is one-half percent.

The effect of treatment using either CABG or PCI differs greatly between treating LM (left main) and 3VD (three vessels) diseases, Hannan and coauthors showed that better HRs for death after CABG *vs.* PCI with BMS, this results was again shown when performing PCI with first-generation DES.[20,21] The ASCERT study which considered the largest study which included about 200,000 patients also showed that mortality was less with CABG than after PCI 6.4 *vs.* 20.8 per cent, respectively.[22] The stroke rates were here after CABG, compared to PCI, but this increase was not significant, also the strokes were evident only in the first year, then it declines.[23] Reducing the incidence of stroke could be achieved using off-pump surgery,[24] while reducing the incidence of MI and improving the quality of the patient's life could be done by using intraoperative graft flow measurements.

Several newer-generation DES have replaced the primary generation ones as they show less MI, stroke and repeat revascularization for example using the paclitaxel-eluting stent in the SYNTAX trial.[25] Although DES of the newer generation could decrease the difference between PCI and CABG The primary difference in the method of revascularization is the major contributing factor to the long-term gain seen with CABG, especially in repeat revascularization and MI due to ST. The existing European guidelines include a recommendation for PCI in patients with 3VD and SYNTAX scores equal or less than 22 in accordance with the SYNTAX score data and completeness of revascularization, given that full functional revascularization is possible. However it should be noted that this value of the SYNTAX score can often be ignored when important factors other than anatomical complete revascularization are important.[26]

PCI with the use of everolimus-eluting stents was not superior to CABG in a randomized study involving patients with multivessel coronary artery disease with regard to significant adverse cardiovascular events at two years of age.

CABG was associated with a lower risk of significant adverse cardiovascular conditions than PCI in longer-term follow-up. Some analysis shown the decrease in the mortality with surgery in diabetic patients was not significant. In BARI 2D, 5-year findings showed a modest survival gain (13.6 per cent *vs.* 16.4 per cent all-cause mortality) for surgery versus intensive medical care, without achieving significance for surgery versus intensive medical treatment.[27,28]

Conclusion

Revascularization in treating coronary artery disease could be conducted either by CABG or PCI, CABG show better result as it cause less death, MI and revascularization rates, while the rate of strokes is higher but it remains insignificant. Usage of new additions such as second-generation DES, can also improve the safety and efficacy of PCI when added to it. Understanding the safety and efficacy of the strategies is important especially when dealing with diabetic patients due to high mortality due to cardiovascular diseases.

References

1. Hlatky MA, Boothroyd DB, Bravata DM, et al. Coronary artery bypass surgery compared with percutaneous coronary interventions for multivessel disease: a collaborative analysis of individual patient data from ten randomised trials. Lancet. 2009;373: 1190–1197.
2. The Bypass Angioplasty Revascularization Investigation (BARI) Investigators. Comparison of coronary bypass surgery with angioplasty in patients with multivessel disease. N Engl J Med. 1996;335:217–25. [Erratum, N Engl J Med 1997; 336:147.]
3. Hillis LD, Smith PK, Anderson JL, et al. 2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Circulation. 2011;124:2610–42. [Erratum, Circulation 2011;124(25):e9956.]
4. Chesebro JH, Fuster V. Platelet inhibitors in coronary artery bypass operations. N Engl J Med. 1982;307:1453–4.
5. Chesebro JH, Fuster V, Elveback LR, et al. Effect of dipyridamole and aspirin on late vein graft patency after coronary bypass operation. N Engl J Med. 1984;310:209–14.
6. Farkouh ME, Domanski M, Sleeper LA, et al. Strategies for multivessel revascularization in patients with diabetes. N Engl J Med. 2012;367(25):2375–2384.
7. Kapur A, Hall RJ, Malik IS, et al. Randomized comparison of percutaneous coronary intervention with coronary artery bypass grafting in diabetic patients: 1-year results

of the CARDia (Coronary Artery Revascularization in Diabetes) trial. J Am Coll Cardiol. 2010;55(5):432–440.
8. Head SJ, Devierwala PM, Serruys PW, et al. Coronary artery bypass grafting vs. percutaneous coronary intervention for patients with three-vessel disease: final five-year follow-up of the SYNTAX trial. Eur Heart J. 2014;35(40):2821–2830.
9. Park SJ, Ahn JM, Kim YH, et al. Trial of everolimus-eluting stents or bypass surgery for coronary disease. N Engl J Med. 2015:372(13):1204–1212.
10. Kamalesh M, Sharp TG, Tang XC, et al. Percutaneous coronary intervention versus coronary bypass surgery in United States veterans with diabetes. J Am Coll Cardiol. 2013;61(8):808–816.
11. Sianos G, Morel MA, Kappetein AP, et al. The SYNTAX Score: an angiographic tool grading the complexity of coronary artery disease. EuroIntervention 2005;1:219–27.
12. Investigators TB. Influence of diabetes on 5-year mortality and morbidity in a randomized trial comparing CABG and PTCA in patients with multivessel disease: the Bypass Angioplasty Revascularization Investigation (BARI). Circulation. 1997;96:1761–9.
13. Ferguson JJ. NHLI BARI clinical alert on diabetics treated with angioplasty. Circulation. 1995;92:3371.
14. Serruys PW, Ong AT, van Herwerden LA, et al. Five-year outcomes after coronary stenting versus bypass surgery for the treatment of multivessel disease: the final analysis of the Arterial Revascularization Therapies Study (ARTS) randomized trial. J Am Coll Cardiol. 2005;46:575–81.
15. Palmerini T, Biondi-Zoccai G, Reggiani LB, et al. Risk of stroke with coronary artery bypass graft surgery compared with percutaneous coronary intervention. J Am Coll Cardiol. 2012;60:798–805.
16. Serruys PW, Morice MC, Kappetein AP, et al. Percutaneous coronary intervention versus coronary-artery bypass grafting for severe coronary artery disease. N Engl J Med. 2009;360:961–72.
17. Harris MI, Flegal KM, Cowie CC, et al. Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults. The Third National Health and Nutrition Examination Survey, 1988–1994. Diabetes Care. 1998;21:518–24.
18. Harris MI. Diabetes in America: epidemiology and scope of the problem. Diabetes Care. 1998;21 Suppl 3:C11–4.
19. Kannel WB, McGee DL. Diabetes and cardiovascular disease. The Framingham study. JAMA. 1979;241:2035–8.
20. Hannan EL, Racz MJ, Walford G, et al. Long-term outcomes of coronary-artery bypass grafting versus stent implantation. N Engl J Med. 2005;352:2174–2183.
21. Hannan EL, Wu C, Walford G, et al. Drug-eluting stents vs. coronary-artery bypass grafting in multivessel coronary disease. N Engl J Med. 2008;358:331–341.
22. Mack MJ, Head SJ, Holmes DR Jr., et al. Analysis of stroke occurring in the SYNTAX trial comparing coronary artery bypass surgery and percutaneous coronary intervention in the treatment of complex coronary artery disease. JACC Cardiovasc Interv. 2013;6:344–354.
23. Head SJ, Borgermann J, Osnabrugge RL, et al. Coronary artery bypass grafting: part 2 – optimizing outcomes and future prospects. Eur Heart J. 2013;34:2873–2886.
24. Jokinen JJ, Werkkala K, Vainikka T, et al. Clinical value of intra-operative transit-time flow measurement for coronary artery bypass grafting: a prospective angiography-controlled study. Eur J Cardiothorac Surg. 2011;39:918–923.
25. Stefanini GG, Holmes DR Jr. Drug-eluting coronary-artery stents. N Engl J Med. 2013;368:254–265.
26. Developed with the special contribution of the European Association for Percutaneous Cardiovascular Interventions (EAPCI), Wijns W, Kolh P, Danchin N, et al. Guidelines on myocardial revascularization. Eur Heart J 2010;31:2501–2555.
27. Chaitman BR, Hardison RM, Adler D, et al. The Bypass Angioplasty Revascularization Investigation 2 Diabetes randomized trial of different treatment strategies in type 2 diabetes mellitus with stable ischemic heart disease. Impact of treatment strategy on cardiac mortality and myocardial infarction. Circulation. 2009;120:2529–40.
28. The BARI 2D Study Group. A randomized trial of therapies for type 2 diabetes and coronary artery disease. N Engl J Med. 2009;360:2503–15.

PEER REVIEW

Not commissioned. Externally peer reviewed.

CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

FUNDING

None

Table 1: Author, country, year of publication, methodology and results

Author, Publishing Year	Objective and Methodology	Results and Conclusion
Farkouh, Michael E, et al.[6] (2012)	It is a randomized trial, where diabetic patients were treated either using PCI with drug-eluting stents or CABG , followed for two years, then measuring outcomes which are; death, MI and strokes. This study aims to study the effect of using aggressive medical therapy or drug-eluting stents on the diabetic patients assigned to have revascularization.	The primary outcomes in diabetic patients were shown by the PCI group comparing to CABG group, while myocardial infarction and death rates was higher in PCI than CABG group. The incidence of strokes was opposite of the previously mentioned statistics as strokes were higher in the PCI group when compared to CABG group as the rate of stroke was 5.2% in the CABG group and 2.4% in the PCI group. The secondary outcomes such as bleeding were also higher in the first 30 days in CABG group than PCI group.
Kapur, Akhil, et al.[7] (2010)	A study of 510 diabetic patients, from 24 different centers. This study aims to compare CABG to PCI) with stenting regarding efficacy and safety.	Higher rates of myocardial infarction, strokes and death was shown by PCI compared to CABG, the rates were 13.0% and 10.5 % respectively, where the all-cause mortality rates for both groups was the same. Also combining DES with CABG improved its effect.
Head, Stuart J., et al.[8] (2014)	SYNTAX trial to study the effect of CABG against percutaneous coronary intervention (PCI) using drug-eluting stents for treating patients with three-vessel disease.	CABG should be the first choice as It showed less death, MI and repeat revascularization rates.
Park, Seung-Jung, et al.[9] (2015)	Randomized noninferiority trial on 1776 patients to CABG to PCI after adding second-generation drug-eluting stents to PCI.	Rate of cardiovascular effects was higher in PCI with everolimus-eluting stents than CABG.
Kamalesh, Masoor, et al.[10] (2013)	Multicenter study of 198 patients with diabetes to identify the best coronary revascularization way for diabetic patients.	The study was not completed, it cannot be used to conclude or compare the two strategies especially for the primary outcomes.