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# COMPARING OUTCOMES OF PERCUTANEOUS CORONARY INTERVENTION OF NATIVE ARTERY VERSUS BYPASS GRAFT IN PATIENTS WITH PRIOR CORONARY ARTERY BYPASS GRAFTING : A SYSTEMATIC REVIEW

**Annisa Tria Fadilla[1], Reza Tri Sutrisno[2], Zainal Arifin Rambe[3], Aulia Doli Namora Siregar[4], Faisal Syahroni Nasution[3], Muhammad Sabri[3*]**

*[1]Madani General Hospital, Pekanbaru, Indonesia*
*[2]dr. Adhyatma, MPH General Hospital, Central Java, Indonesia*
*[3*]Faculty of Medicine, Islamic University of North Sumatra, Indonesia*
*[4]Robert Wolter Mongisidi National Army Hospital, Manado, Indonesia*

***Corresponding Author:***
*sabriaby03@gmail.com*

## Abstract

***Background:*** *Percutaneous coronary intervention (PCI) is common in patients with prior coronary artery bypass graft surgery (CABG), however the data on the association between the PCI target-vessel and clinical outcomes are not clear. We aimed to investigate long-term clinical outcomes of patients with prior CABG who underwent PCI of either bypass graft or native artery. We performed a systematic review of observational studies comparing PCI of either bypass graft or native artery in patients with prior CABG.*

***Methods:*** *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2013 and 2023 were taken into account. Several different online reference sources, like Pubmed and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

***Result:*** *In the PubMed database, the results of our search brought up 23 articles, whereas the results of our search on SagePub brought up 19 articles. The results of the search conducted for the last year of 2013 yielded a total 9 articles for PubMed and 5 articles for SagePub. In the end, we compiled a total of 5 papers, 4 of which came from PubMed and 1 of which came from SagePub. We included five research that met the criteria.*

***Conclusion:*** *Most PCIs performed in prior CABG patients are done in native coronary artery lesions. Compared with native coronary PCI, bypass graft PCI is independently associated with higher in-hospital mortality.*

**Keyword:** *Percutaneous coronary intervention, native artery, bypass graft, prior coronary artery bypass grafting*

## INTRODUCTION

Saphenous vein graft (SVG) remains the predominant conduit in patients undergoing coronary artery bypass graft surgery (CABG) despite inferior patency rates. SVG failure is common with a different pathophysiology from native coronary artery disease, including compliance mismatch between artery and vein and accelerated atherosclerosis. Despite better use of secondary prevention measures in patients with prior CABG, only about half of SVGs are patent at 10 years and many of those have significant atherosclerosis.[1] SVG failure is associated with increased morbidity and mortality. Repeat CABG poses a significant surgical challenge with increased mortality and therefore rarely performed in contemporary practice, especially with the advancements of chronic total occlusion (CTO) interventions. Complex percutaneous coronary intervention (PCI) of degenerated SVGs and native coronary arteries has become a common scenario. SVG PCI accounts for approximately 6% of all PCI procedures and carries an increased risk for procedural complications, such as distal embolization and no reflow. This is mainly due to the fact that degenerated SVG plaques are usually soft and friable with a high content of thrombotic material and inflammatory cells. Late complications are also frequent due to in-stent restenosis and emergence of new lesions requiring multiple repeat revascularization procedures.[2]

In contrast to native coronary artery lesions, drugeluting stents (DES) do not seem to improve outcomes compared to bare metal stents in SVG lesions. CABG does lead to accelerated native artery lesions progression with calcification due to changes in hydraulic factors, resulting in an increase in the rate as well as complexity of CTOs in this cohort. Increased native artery CTO PCI complexity is associated with reduced procedural success and increased complications.[3]

It is widely believed that native coronary arteries should be the preferred target of percutaneous coronary intervention (PCI) in patients with prior coronary artery bypass graft (CABG) surgery, if technically feasible, because native coronary artery PCI appears to be associated with better short-and long-term outcomes compared with bypass graft PCI. However, there are limited data to substantiate this belief.[3]

Patients with prior coronary artery bypass graft (CABG) surgery often require repeat revascularization either due to graft failure or a combination of graft failure and progression of coronary atherosclerosis. Thrombosis, intimal hyperplasia and atherosclerosis are the main pathological processes underlying saphenous venous grafts disease. Early thrombosis is the principle cause of vein graft attrition during the first month after bypass surgery, with intimal hyperplasia being an issue during the remainder of the first year. Thereafter, atherogenesis predominates. [4]

For patients with prior CABG who require repeat revascularization, percutaneous coronary intervention (PCI) is usually the preferred strategy, rather than redo CABG, because of the low procedural mortality and similar long-term outcome, combined with placement o f a drug-eluting stent (DES). Despite a number of studies investigating the impact that diabetes has on the clinical outcome of PCI with DES in patients without prior CABg, little is known about the influence of diabetes on outcomes of PCI with DES in patients who have previously undergone CABG.[5]

The optimal revascularization strategy of patients with prior CABG and graft failure remains a subject of debate. Redo surgeries are associated with higher morbidity and mortality as well as poorer outcomes compared to initial operations. Furthermore, there is limited evidence on the optimal percutaneous coronary intervention (PCI) option (i.e. native coronary artery or graft PCI) in such population. Present study was conducted to compare 1-year major adverse cardiac events (MACE) of native versus graft PCI.[6]

## METHODS

### Protocol

By following the rules provided by Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, the author of this study made certain that it was up to par with the requirements. This is done to ensure that the conclusions drawn from the inquiry are accurate.

### Criteria for Eligibility

For the purpose of this literature review, we review assessed evidence on the impact of prior coronary artery bypass grafting on outcomes of percutaneous coronary intervention. This is done to provide an explanation and improve the handling of treatment at the patient. As the main purpose of this paper, to show the relevance of the difficulties that have been identified as a whole.

In order for researchers to take part in the study, it was necessary for them to fulfil the following requirements: 1) The paper needs to be written in English. In order for the manuscript to be considered for publication, it needs to meet both of these requirements. 2) The studied papers include several that were published after 2013, but before the time period that this systematic review deems to be relevant. Examples of studies that are not permitted include editorials, submissions that do not have a DOI, review articles that have already been published, and entries that are essentially identical to journal papers that have already been published.

### Search Strategy

We used "percutaneous coronary intervention vs bypass graft" as keywords.The search for studies to be included in the systematic review was carried out using the PubMed and SagePub databases by inputting the words: *("percutaneous coronary intervention"[MeSH Terms] OR ("percutaneous"[All Fields] AND "coronary"[All Fields] AND "intervention"[All Fields]) OR "percutaneous coronary intervention"[All Fields]) AND "vs"[All Fields] AND ("bypass"[All Fields] OR "bypassed"[All Fields] OR "bypasses"[All Fields] OR "bypassing"[All Fields]) AND ("graft s"[All Fields] OR "grafted"[All Fields] OR "graftings"[All Fields] OR "transplantation"[MeSH Subheading] OR "transplantation"[All Fields] OR "grafting"[All Fields] OR "transplantation"[MeSH Terms] OR "grafts"[All Fields] OR "transplants"[MeSH Terms] OR "transplants"[All Fields] OR "graft"[All Fields])* used in searching the literature.

**Data retrieval**

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

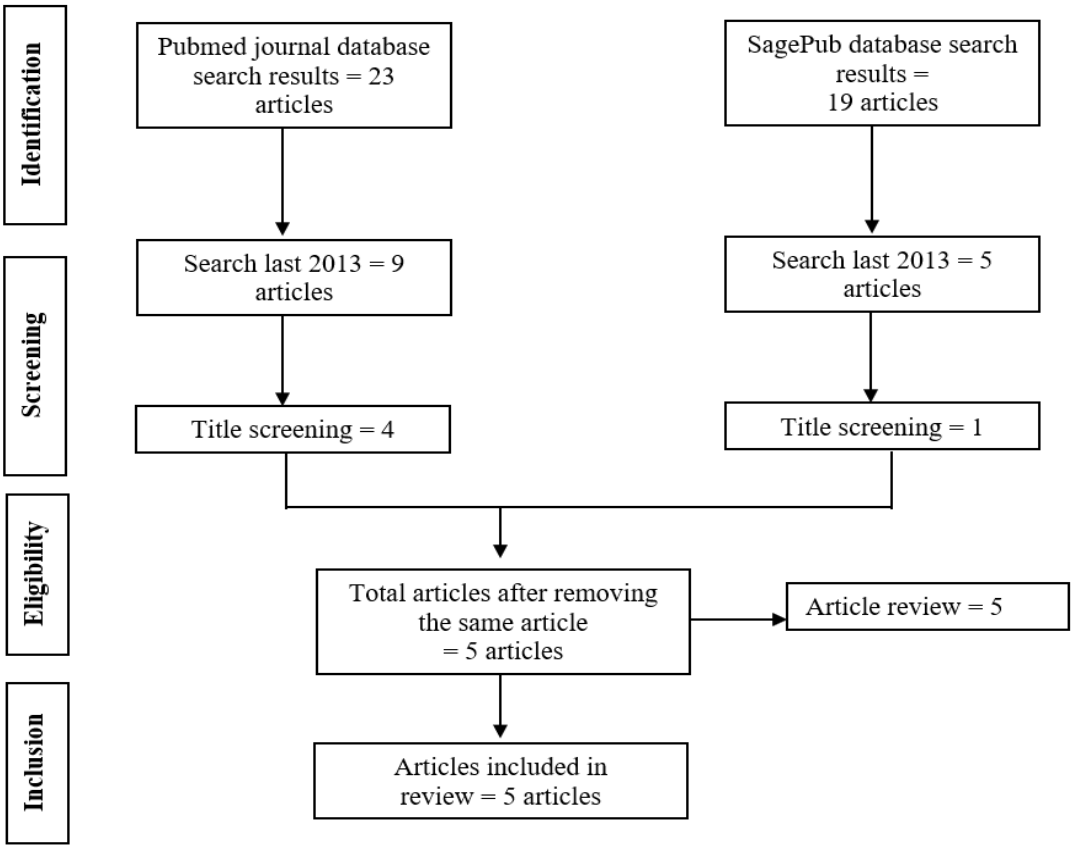


**Figure 1. Article search flowchart**

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

**Quality Assessment and Data Synthesis**

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

**RESULT**

In the PubMed database, the results of our search brought up 23 articles, whereas the results of our search on SagePub brought up 19 articles. The results of the search conducted for the last year of 2013 yielded a total 9 articles for PubMed and 5 articles for SagePub. In the end, we compiled a total of 5 papers, 4 of which came from PubMed and 1 of which came from SagePub. We included five research that met the criteria.

Brilakis, et al[3] (2016) showed that in a national cohort of veterans, almost three-quarters of PCIs performed in patients with prior CABG involved native coronary artery lesions. Compared with native coronary PCI, bypass graft PCI was significantly associated with higher incidence of short- and long-term major adverse events, including more than double the rate of in-hospital mortality.

Nikolakopoulos, et al[7] (2020) showed that compared with non-prior CABG patients, prior CABG patients undergoing CTO-PCI had lower technical success and higher incidence of acute and follow-up adverse cardiovascular events.

**Table 1. The litelature include in this study**

| Author | Origin | Method | Sample | Result |
|---|---|---|---|---|
| **Brilakis et al, 2016**[3] | USA | Cohort study | 11.118 patients | During the study period, patients with prior CABG represented 18.5% of all patients undergoing PCI (11,118 of 60,171). The PCI target vessel was a native coronary artery in 73.4% and a bypass graft in 26.6%: 25.0% in a saphenous vein graft and 1.5% in an arterial graft. Compared with patients undergoing native coronary artery PCI, those undergoing bypass graft PCI had higher risk characteristics and more procedure-related complications. During a median follow-up period of 3.11 years, bypass graft PCI was associated with significantly higher mortality (adjusted HR: 1.30; 95% confidence interval: 1.18 to 1.42), myocardial infarction (adjusted HR: 1.61; 95% confidence interval: 1.43 to 1.82), and repeat revascularization (adjusted HR: 1.60; 95% confidence interval: 1.50 to 1.71). |
| **Nikolakopoulos et al, 2020**[7] | Multicentric | Retrospective study | 1.572 patients | Prior CABG patients had higher J-CTO scores (2.9 ± 1.1 vs 2.2 ± 1.3; P<.001) and were less likely to undergo PCI of the left anterior descending artery (16.7% vs 29.6%; P<.001). The retrograde technique was used more often (47.4% vs 28.2%; P<.001) and was successful more often (27.4% vs 17.1%; P<.001) in the prior CABG group vs the non-prior CABG group. Technical success was lower in prior CABG patients (82.6% vs 87.9%; P<.01) with similar incidence of in-hospital major adverse cardiovascular events (3.4% vs 3%; P=.65), although in-hospital mortality was higher in the prior CABG group (2.4% vs 1.0%; P=.04). At 1-year follow-up, the composite endpoint of death, myocardial infarction, and revascularization was higher in prior CABG patients (21.79% vs 12.73%; hazard ratio, 1.76; 95% confidence interval, 1.27-2.45; P<.001). |
| **Hernandez-Suarez et al, 2022**[8] | Multicentric | Retrospective study | 1.662 patients | A total of 1,662 patients were included [n=1411 (84.9%) no-CABG and n=251 (15.1%) prior-CABG]. Compared with no-CABG, those with prior-CABG were older (67±11 vs. 64±11 years; p<0.001), had more comorbidities and lower left ventricular ejection fraction (52.8±12.8% vs. 54.4±11.7%; p=0.042). Anatomic complexity was higher in the prior-CABG group (J-CTO score 2.46±1.19 vs. 2.10±1.22, p<0.001; PROGRESS CTO score 1.28±0.89 vs. 0.91±0.85, p<0.001). Absence of CABG was associated with lower risk of technical and procedural failure (OR 0.60, 95% CI 0.43–0.85 and OR 0.58, 95% CI, 0.40–0.83, respectively). No significant differences in the incidence of in-hospital MACCE (3.8% no-CABG vs. 4.4% prior-CABG; p=0.766) were observed between groups. |
| **Shoaib et al, 2022**[9] | United Kingdom | Prospective study | 20.081 | Patients in group 2 were older, had more comorbidities and higher prevalence of severe left ventricular systolic dysfunction. Following multivariable analysis, no significant difference in mortality was observed during index hospital admission (OR:1.33, CI 0.64-2.78, p = .44), at 30-days (OR: 1.28, CI 0.79-2.06, p = .31) and 1 year (OR:1.02, CI 0.87-1.29, p = .87). Odds of in-hospital major adverse cardiovascular events (MACE) (OR:1.01, CI 0.69-1.49, p = .95) and procedural complications (OR:1.02, CI 0.88-1.18, p = .81) were similar between two groups but procedural success rate was lower in group 2 (OR: 0.34, CI 0.31-0.39, p < .001). The adjusted risk of target vessel revascularization (TVR) remained similar between the two groups at 30-days (OR:0.68, CI 0.40-1.16, P-0.16) and at 1 year (OR:1.01, CI 0.83-1.22, P-0.95). |
| **Toma et al, 2016**[10] | Germany | Retrospective study | 2.002 | The primary outcome measure was all-cause mortality. Median follow-up was 2.6 years (interquartile range 1.1 to 3.1). A total of 292 patients (15%) had previous CABG; they were older and had a greater prevalence of comorbidities. Procedural success was achieved in 75% and 84% of patients in the previous CABG and the non-CABG groups (p <0.001), respectively. All-cause mortality was 16% and 11% in the previous CABG and the non-CABG groups (p = 0.002), and differences were mitigated after adjustment for baseline characteristics (adjusted hazard ratio [HR] 1.22, 95% confidence interval [CI] 0.86 to 1.74, p = 0.27). All-cause death was significantly reduced in patients with procedural |

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| | | | | success, both in the previous CABG (11% vs 32%, adjusted HR 0.43, 95% CI 0.24 to 0.77, p = 0.005) and the non-CABG groups (10% vs 20%, adjusted HR 0.63, 95% CI 0.45 to 0.86, p = 0.004), with similar mortality benefits associated with successful revascularization in both groups (interaction p = 0.24). |

Hernandez-Suarez, et al[8] (2022) showed that in a contemporary multicenter CTO-PCI registry from Latin America, prior-CABG patients had more comorbidities, higher anatomical complexity, lower success, and similar in-hospital adverse event rates compared with no-CABG patients.
Shoaib, et al[9] (2022) showed that patients with prior CABG presenting with stable angina and treated with CTO PCI in native arteries had more co-morbid illnesses but once these differences were adjusted for, prior CABG did not independently confer additional risk of mortality, MACE or TVR.
Toma, et al[10] (2016) showed that the relative survival benefit of successful recanalization of CTO is independent of previous CABG. However, owing to a greater baseline risk, the absolute survival benefit of successful CTO procedures is more pronounced in patients with previous CABG than in non-CABG patients.

## DISCUSSION

The continuous refinement of PCI has contributed to a significant reduction in adverse cardiac events in recent years. In prior CABG patients, employing the percutaneous intervention strategy that provides the safest and durable revascularization with a lower risk of in-stent restenosis should be prioritized. Whenever technically feasible, treating native coronary arteries may be preferable to treating SVGs and as advocated in recent practice guidelines. However, no prospective comparative data are available to support this approach and the consensus is to decide on an individual basis.[3]
In the present study, patients who underwent bypass graft rather than native coronary PCI were older, had more comorbidities, and were more likely to receive bare-metal stents, which may in part explain the worse clinical outcomes in this patient group. Although statistical adjustment may be imperfect in retrospective studies, our multivariate analyses confirmed that bypass graft (essentially SVG) PCI was significantly associated with worse outcomes. SVG lesions are often degenerated, complex lesions that may predispose to distal embolization. Indeed, SVG PCI was associated with higher risk for no-reflow and periprocedural MI in our study, even though embolic protection devices are used more commonly in the VA system (38%) compared with general practice, as reported by the NCDR (22%). Similar findings were reported in prior studies, including in patients with ST-segment elevation acute MI: in the APEX-AMI (Assessment of Pexelizumab in Acute Myocardial Infarction) trial in patients with prior CABG who presented with ST-segment elevation MI, TIMI flow grade 3 was achieved less often in bypass grafts (67% vs. 88%), and bypass graft PCI patients had higher 90-day mortality (19% vs. 5.7%) compared with native artery PCI patients.[11]

Even with use of DES (including second-generation DES), repeat revascularization is higher after SVG compared with native coronary artery PCI, likely because of higher rates of inflammation and thrombus formatio.. Moreover, intermediate SVG lesions have high rates of progression and failure, leading to increased need for repeat revascularization. Rates of MI were also higher among patients undergoing SVG PCI in our study, which could reflect the increased likelihood of SVG stent failure to present as an acute coronary syndrome or as complete occlusion. Patients who underwent SVG PCI were less likely to receive DES, which could be due to safety concerns (higher mortality was observed with DES in the RRISC [Reduction of Restenosis in Saphenous vein grafts With Cypher sirolimus-Eluting Stent] trial and more comorbidities, potentially raising concerns about the feasibility of long-term dual-antiplatelet therapy in these patients.[12]
It is clear from available evidence that bypass graft PCI is associated with worse short- and long-term clinical outcomes compared to native coronary artery PCI, but there may be an equipoise between both treatments in unstable patients. To date, all studies were conducted retrospectively with all the inherent limitations of the observational design, and therefore the results should be interpreted with great caution. These studies were subjected to bias toward patient selection, technique, and operator's skill level. They also suffer from heterogeneity in the regime and duration of antiplatelet treatment and contemporary pharmacotherapy was not used. Moreover, PCI was undertaken in many patients using balloon angioplasty only, and hence the applicability of these studies to contemporary practice is unclear.[2]

## CONCLUSION

In studies involving all-comers with prior CABG, bypass graft PCI appears to be associated with higher short- and long-term adverse cardiac events compared to native coronary artery PCI. Whenever feasible, in prior CABG patients with a clear indication for revascularization, the data from our review suggest that native coronary artery PCI should be the prioritized treatment.

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