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Comparison Between Culprit-Lesion Only and Complete PCI in Patients with STEMI and Multivessel Disease: A Literature Review

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ABSTRACT

Cardiovascular diseases, particularly Coronary Artery Disease (CAD), remain a leading cause of global mortality, with Acute Coronary Syndrome (ACS) being a major manifestation. Among ACS conditions, ST-elevation Myocardial Infarction (STEMI) is associated with significant morbidity and mortality, especially in patients with multivessel coronary artery disease (MVD). Percutaneous coronary intervention (PCI) of the culprit lesion has long been the standard approach for STEMI, but the role of complete revascularization, involving PCI of both the culprit and non-culprit lesions, remains a subject of debate. This literature review compares culprit-lesion-only PCI and complete PCI in patients with STEMI and multivessel disease. Studies show that complete PCI is associated with a significant reduction in cardiovascular death, myocardial infarction, and the need for repeat revascularization, compared to culprit-lesion-only PCI. Furthermore, early complete revascularization, particularly guided by physiology, appears to improve long-term survival and reduce major adverse cardiovascular events. These findings suggest that complete PCI may be the preferred strategy for patients with STEMI and multivessel disease, offering improved prognosis by addressing high-risk coronary plaques early in the disease process.

Keywords: STEMI; Multivessel Disease; Culprit-Only Lesion; Complete PCI.

INTRODUCTION

Cardiovascular diseases are a pressing health issue, accounting for about one-third of global deaths [1]. The prevalence of cardiovascular diseases has nearly doubled, from 271 million people in 1990 to 523 million people in 2019 [2]. According to the World Health Organization (WHO), cardiovascular diseases are the leading cause of death worldwide, resulting in approximately 17.9 million deaths in 2019, contributing to around 32% of total deaths [3]. One of the most common heart diseases is Coronary Artery Disease (CAD). The serious condition of coronary artery disease occurs in the acute stage, also known as Acute Coronary Syndrome (ACS). The underlying cause of acute coronary syndrome is atherosclerosis, which is the process of plaque formation that can damage the arterial intima and lead to the formation of a thrombus, narrowing the lumen and ultimately disrupting blood flow, thereby weakening the heart's ability to contract [4].

Acute Coronary Syndrome (ACS) can be divided into ST-elevation Myocardial Infarction (STEMI), Non-ST-elevation Myocardial Infarction (NSTEMI), and unstable angina [5]. Annually, over 3 million people develop STE-MI, and over 4 million people have STE-MI pathology. While MI is most frequently found in developed countries, it is similarly found in emerging countries [6].

Controlling risk factors, accurate diagnosis, and following established guidelines are crucial for managing STEMI. Reperfusion therapy, including primary PCI or fibrinolytics, plays a central role in STEMI treatment [7]. Nearly one-third of patients who undergo cardiac catheterisation in the acute setting of STEMI have multiple vessel coronary artery disease (MV). Those with MV CAD had a higher risk of major adverse cardiac events (MACE) in the first year after index PCI than those with single vascular disease [8].

Percutaneous coronary intervention (PCI) of the -lesion lowers the risk of myocardial infarction or cardiovascular death in patients with ST-segment elevation myocardial infarction (STEMI). It is uncertain if PCI of non-culprit lesions lowers the likelihood of such occurrences even further. Whether to use MV PCI for revascularization or PCI of the culprit-lesion solely (CLO) is still up for argument [8, 9]. This literature review aims to compare the outcomes of culprit-lesion-only PCI and complete PCI in patients with STEMI and multivessel coronary artery disease. It seeks to evaluate the benefits and risks of both strategies in terms of clinical outcomes, including mortality, morbidity, and recurrent ischemic events.

DEFINITION

- **STEMI**

ST-elevation Myocardial Infarction (STEMI) is the most acute manifestation of coronary artery disease, associated with high morbidity and mortality. In most cases, the epicardial coronary vessels experience complete thrombotic occlusion that develops from an atherosclerotic plaque, leading to STEMI. Early diagnosis and immediate reperfusion are the most effective methods to limit myocardial ischemia and infarct size, thereby reducing the risk of post-STEMI complications and heart failure [10]. A patient is classified as having STEMI if they meet the criteria of acute chest pain indicative of myocardial infarction and persistent ST-segment elevation (>20 minutes) on the ECG. Also, the electrocardiogram's result specifically shows the presence of significant T waves and ST-segment elevation myocardial infarction (STEMI; ≥2 mm ST segment elevation). In many cases, the myocardial area affected by acute ischaemia determines where ST-segment alterations occur [5, 11].

- **Multivessel disease**

Multivessel coronary artery disease (MVD) is characterized by 50% or more stenosis of the left main trunk and luminal stenosis of at least 70% in at least two major coronary arteries or one coronary artery. It is both prevalent and lethal: Compared to single-vessel disease, MVD has a mortality hazard ratio of 3.14 and affects 45% to 88% of men with angina [12]. Approximately 50% of individuals with acute coronary syndrome (ACS) have atherosclerosis that affects the whole coronary tree or multiple vessels. The prognosis for ST-elevation myocardial infarction (STEMI) with multivessel disease is poorer than that with single-vessel disease [13].

SIGNS AND SYMPTOMS

Acute chest discomfort, which can be described as pain, pressure, tightness, heaviness, or burning, is the primary symptom that prompts clinical consideration of Acute Coronary Syndrome (ACS) diagnosis [14]. The pain may radiate to the teeth, lower jaw, neck, arms, back, and abdomen, which are common symptoms in STEMI patients. Additionally, pain in the epigastric region can lead to gastrointestinal disturbances such as nausea and vomiting. Chest discomfort may also cause shortness of breath, anxiety, cold sweats, weakness, and fatigue from daily activities. All of these symptoms can interfere with the quality of sleep in STEMI patients [15]. Awareness of symptoms associated with ACS should be high among the general public, particularly warning signs such as prolonged chest pain (>15 minutes) and/or recurring pain within one hour. These signs should be promptly recognized by the patient or family members to seek immediate medical assistance. Continuous education and promotion efforts are vital to ensure this information is widely available to the public [14].

"TIME IS MUSCLE"

Most STEMI patients who die from a heart attack die in the early stages of myocardial infarction, usually before reaching the hospital. One of the main issues is the need for rapid access to emergency medical care [16]. "Time is muscle" is a revolutionary hypothesis proposed by Eugene Braunwald, which demonstrated that timely intervention, at most 3 hours after coronary obstruction, can alter the severity and extent of myocardial ischemic injury caused by coronary occlusion [17]. A retrospective cohort study by Nepper-Christensen et al. concluded that an increased duration from symptom onset to PPCI is associated with a higher risk of poor clinical outcomes in STEMI patients, which can lead to hospitalization due to heart failure or death [18].

MANAGEMENT

Based on the ESC Guideline, when heart attack symptoms occur, it is crucial to seek immediate help by going to the hospital or contacting emergency medical services (EMS). The treatment plan depends on the type of hospital: if it is a PCI centre, the goal is to perform a procedure to open the blocked artery within 60 minutes. If it is not a PCI centre, the patient should be transferred to a PCI centre within 90 minutes, or receive thrombolytic medication within 10 minutes if a transfer is not possible within 120 minutes. Reducing delays from the onset of symptoms to treatment will increase the chances of recovery by restoring blood flow to the heart quickly [15].

CULPRIT-LESION ONLY PCI

Culprit-Lesion Only PCI refers to the percutaneous coronary intervention (PCI) performed solely on the coronary artery that is responsible for causing the acute STEMI. This approach focuses on revascularizing the artery that is directly responsible for the acute ischaemic event rather than treating more stenotic or occluded vessels (in the case of multivessel disease). It is typically chosen in the acute setting when time is critical to restore blood flow to the ischemic myocardium, and it is commonly performed in patients with STEMI and unstable hemodynamics or those in cardiogenic shock. The purpose of culprit-lesion-only PCI is to promptly clear the blockage in the artery that caused the infarction, which will improve haemodynamics, stop more myocardial damage, and lower the chance of early death. This approach may be successful in the short term, but it may fail to treat other non-culprit lesions, which could result in problems or further ischaemic episodes. [10, 19].

COMPLETE PCI

Complete PCI refers to the approach where all significant coronary artery lesions in patients with multivessel coronary artery disease (CAD) are treated during the same procedure. This approach aims to restore blood flow not just to the artery responsible for the acute STEMI (culprit lesion), but also to any other clinically significant lesions in the remaining coronary arteries.

The goal of complete revascularization is to improve long-term outcomes by reducing the risk of recurrent myocardial infarction (MI), cardiovascular mortality, and the need for repeat revascularization. It is considered particularly beneficial in patients with multivessel disease, as it reduces the risk of untreated ischemia in non-culprit vessels that could lead to adverse cardiovascular events in the future. [9,20].

COMPARISON BETWEEN CULPRIT-ONLY AND COMPLETE PCI

According to a multinational RCT with a total of 4041 patients with a median follow-up of three years, patients with STEMI and multivessel coronary artery disease who underwent staged non-culprit lesion PCI with the aim of complete revascularization had a 26% lower risk of a composite of death from cardiovascular causes or new myocardial infarction than those who underwent culprit-lesion-only PCI [9]. Another multicenter, randomized trial with a total of 1445 patients with STEMI and multivessel disease who underwent CLO PCI and complete PCI showed that those who had physiology-guided complete revascularization had a decreased composite risk of death, myocardial infarction, stroke, or ischemia-driven revascularization at one year [20].

A systematic review and meta-analysis study including 7 RCTs with a total of 2006 patients with STEMI and multivessel disease discovered that patients undergoing primary PCI who underwent complete PCI instead of the CLO approach experienced a significant decrease in major adverse cardiovascular events (MACE) (OR, 0.62; 95% CI, 0.43-0.90), cardiovascular mortality (OR, 0.46; 95% CI, 0.27-0.80), and repeat revascularization (RRV) (OR, 0.39; 95% CI, 0.30-0.51)[8]. Another meta-analysis study including 12 RCTs with a total of 7592 patients showed that there was a significantly lower risk of MACE (HR 0.61; 95% CI (0.43-0.60), cardiovascular mortality (HR 0.74; 95% CI (0.56-0.99), and repeat revascularization (HR 0.43; 95% CI (0.31-0.59) in patients treated with complete compared with culprit-only revascularization [21].

The pathophysiology of coronary disease is most likely linked to the processes by which early full revascularization may enhance prognosis and decrease hard events in individuals with multivessel disease. Early mortality is considerably higher in individuals with multivessel disease, and the risk of adverse outcomes is higher in the first few days and weeks of STEMI and subsequently declines after the first month. The decrease in death and MI seen with an immediate complete revascularisation procedure may be explained by early treatment of high-risk coronary plaques [22].

CONCLUSION

In conclusion, complete PCI in patients with STEMI and multivessel disease significantly improves outcomes compared to culprit-lesion-only (CLO) PCI. Studies show that complete PCI reduces the risk of cardiovascular death, myocardial infarction, and repeat revascularization, with better long-term survival and fewer major adverse cardiovascular events. Early treatment of high-risk plaques appears to be key in improving prognosis and reducing early mortality in these patients.

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REFERENCE

[1] Laffond, A., Rivera-Picón, C., Rodríguez-Muñoz, P. M., Juárez-Vela, R., Ruiz de Viñaspre-Hernández, R., Navas-Echazarreta, N., & Sánchez-González, J. L. (2023). Mediterranean Diet for Primary and Secondary Prevention of Cardiovascular Disease and Mortality: An Updated Systematic Review. *Nutrients*, *15*(15), 3356. https://doi.org/10.3390/nu15153356

[2] Roth, G. A., Mensah, G. A., Johnson, C. O., Addolorato, G., Ammirati, E., Baddour, L. M., Barengo, N. C., Beaton, A. Z., Benjamin, E. J., Benziger, C. P., Bonny, A., Brauer, M., Brodmann, M., Cahill, T. J., Carapetis, J., Catapano, A. L., Chugh, S. S., Cooper, L. T., Coresh, J., & Criqui, M. (2020). Global Burden of Cardiovascular Diseases and Risk Factors, 1990-2019: Update From the GBD 2019 Study. *Journal of the American College of Cardiology*, *76*(25), 2982–3021. https://doi.org/10.1016/j.jacc.2020.11.010

[3] World Health Organization. *Cardiovascular diseases (CVDs)*. Who.int; World Health Organization: WHO. https://www.who.int/en/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

[4] Maulidah, M., Wulandari, S., Tholib, M. A. A., & Octavirani, D. I. P. (2022). Karakteristik Umum Penderita Sindrom Koroner Akut. *Nursing Information Journal*, *2*(1), 20-26.

[5] Hakim, A. R., & Muhani, N. (2020). Hubungan Dislipidemia, Hipertensi, Riwayat Diabetes Melitus Terhadap Kejadian Sindroma Koroner Akut Pada Pasien Poli Jantung Di Rsud Ahmad Yani Metro Lampung 2019. *Jurnal Ilmu Kedokteran dan Kesehatan*, *7*(2), 418-425.

[6] Salari, N., Morddarvanjoghi, F., Abdolmaleki, A., Rasoulpoor, S., Khaleghi, A. A., Hezarkhani, L. A., Shohaimi, S., & Mohammadi, M. (2023). The global prevalence of myocardial infarction: a systematic review and meta-analysis. *BMC cardiovascular disorders*, *23*(1), 206. https://doi.org/10.1186/s12872-023-03231-w

[7] Dharmawan, M., Leonardus, W. H., & Leonora, J. T. (2018). Profil Infark Miokard Akut dengan Kenaikan Segmen-ST di ICCU RSUD Prof. *W. Z. Johannes Kupang, Nusa Tenggara Timur, Januari-April*.

[8] Villablanca, P. A., Briceno, D. F., Massera, D., Hlinomaz, O., Lombardo, M., Bortnick, A. E., Menegus, M. A., Pyo, R. T., Garcia, M. J., Mookadam, F., Ramakrishna, H., Wiley, J., Faggioni, M., & Dangas, G. D. (2016). Culprit-lesion only versus complete multivessel percutaneous intervention in ST-elevation myocardial infarction: A systematic review and meta-analysis of randomized trials. *International journal of cardiology*, *220*, 251–259. https://doi.org/10.1016/j.ijcard.2016.06.098

[9] Mehta, S. R., Wood, D. A., Storey, R. F., Mehran, R., Bainey, K. R., Nguyen, H., ... & Cairns, J. A. (2019). Complete revascularization with multivessel PCI for myocardial infarction. *New England Journal of Medicine*, *381*(15), 1411-1421.

[10] Vogel, B., Claessen, B. E., Arnold, S. V., Chan, D., Cohen, D. J., Giannitsis, E., Gibson, C. M., Goto, S., Katus, H. A., Kerneis, M., Kimura, T., Kunadian, V., Pinto, D. S., Shiomi, H., Spertus, J. A., Steg, P. G., & Mehran, R. (2019). ST-segment elevation myocardial infarction. *Nature Reviews Disease Primers*, *5*(1). https://doi.org/10.1038/s41572-019-0090-3

[11] Kingma, J. G. (2018). Myocardial infarction: An overview of STEMI and NSTEMI physiopathology and treatment. *World Journal of Cardiovascular Diseases*, *8*(11), 498.

[12] Bryer, E., Stein, E., & Goldberg, S. (2020). Multivessel Coronary Artery Disease: The Limitations of a "One-Size-Fits-All" Approach. *Mayo Clinic proceedings. Innovations, quality & outcomes*, *4*(6), 638–641. https://doi.org/10.1016/j.mayocpiqo.2020.07.014

[13] Liu, G., Fan, C. M., Guo, H., Fan, W. N., Li, M. L., & Cui, G. X. (2021). Fibrinogen-to-albumin ratio predicts long-term outcomes for patients with ST-elevation myocardial infarction and multivessel disease: A prospective observational cohort study. *Experimental and Therapeutic Medicine*, *21*(5), 1-9.

[14] Byrne, R. A., Rossello, X., Coughlan, J. J., Barbato, E., Berry, C., Chieffo, A., Claeys, M. J., Dan, G.-A., Dweck, M. R., Galbraith, M., Gilard, M., Hinterbuchner, L., Jankowska, E. A., Jüni, P., Kimura, T., Vijay Kunadian, Leosdottir, M., Lorusso, R., Roberto F.E. Pedretti, & Rigopoulos, A. (2023). 2023 ESC Guidelines for the management of acute coronary syndromes. *European Heart Journal*, *44*(38). https://doi.org/10.1093/eurheartj/ehad191

[15] Mauidhah, M., Jufrizal, J., & Nurhidayah, I. (2022). ASUHAN KEPERAWATAN PADA PASIEN DENGAN ST ELEVASI INFARK MIOKARD (STEMI) DI INTENSIVE CARDIAC CARE UNIT: STUDI KASUS. *Jurnal Ilmiah Mahasiswa Fakultas Keperawatan*, *1*(4).

[16] Koutsoukis, A., & Kanakakis, I. (2019). Challenges and unanswered questions in STEMI management. *Hellenic Journal of Cardiology*, *60*(4), 211–215. https://doi.org/10.1016/j.hjc.2019.01.001

[17] Abreu L. M. (2019). Time is Muscle. *Arquivos brasileiros de cardiologia*, *112*(4), 408–409. https://doi.org/10.5935/abc.20190059

[18] Nepper-Christensen, L., Lønborg, J., Høfsten, D. E., Sadjadieh, G., Schoos, M. M., Pedersen, F., Jørgensen, E., Kelbæk, H., Haahr-Pedersen, S., Flensted Lassen, J., Køber, L., Holmvang, L., & Engstrøm, T. (2021). Clinical outcome following late reperfusion with percutaneous coronary intervention in patients with ST-segment elevation myocardial infarction. *European heartjournal. Acute cardiovascular care*, *10*(5), 523–531. https://doi.org/10.1177/2048872619886312

[19] Thiele, H., Akin, I., Sandri, M., de Waha-Thiele, S., Meyer-Saraei, R., Fuernau, G., Eitel, I., Nordbeck, P., Geisler, T., Landmesser, U., Skurk, C., Fach, A., Jobs, A., Lapp, H., Piek, J. J., Noc, M., Goslar, T., Felix, S. B., Maier, L. S., Stepinska, J., … CULPRIT-SHOCK Investigators (2018). One-Year Outcomes after PCI Strategies in Cardiogenic Shock. *The New England journal of medicine*, *379*(18), 1699–1710. https://doi.org/10.1056/NEJMoa1808788

[20] Biscaglia, S., Guiducci, V., Escaned, J., Moreno, R., Lanzilotti, V., Santarelli, A., Cerrato, E., Sacchetta, G., Jurado-Roman, A., Menozzi, A., Amat Santos, I., Díez Gil, J. L., Ruozzi, M., Barbierato, M., Fileti, L., Picchi, A., Lodolini, V., Biondi-Zoccai, G., Maietti, E., Pavasini, R., … FIRE Trial Investigators (2023). Complete or Culprit-Only PCI in Older Patients with Myocardial Infarction. *The New England journal of medicine*, *389*(10), 889–898. https://doi.org/10.1056/NEJMoa2300468

[21] Al-Abdouh, A., Barbarawi, M., Bizanti, A., Abudaya, I., Upadhrasta, S., Elias, H., Zhao, D., Savji, N., Lakshman, H., Hasan, R., & Michos, E. D. (2020). Complete Revascularization in Patients With STEMI and Multi-Vessel Disease: A Meta-Analysis of Randomized Controlled Trials. *Cardiovascular revascularization medicine : including molecular interventions*, *21*(5), 684–691. https://doi.org/10.1016/j.carrev.2020.01.020

[22] Pasceri, V, Patti, G, Pelliccia, F. et al. Complete Revascularization During Primary Percutaneous Coronary Intervention Reduces Death and Myocardial Infarction in Patients With Multivessel Disease: Meta-Analysis and Meta-Regression of Randomized Trials. *J Am Coll Cardiol Intv.* 2018 May, 11 (9) 833–843. https://doi.org/10.1016/j.jcin.2018.02.028