Culprit Only versus Total Revascularization in Acute Coronary Syndrome Patients Presented with Cardiogenic Shock with Multivessel Disease

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Abstract

Background: Acute coronary syndrome (ACS) with multivessel disease (MVD) and cardiogenic shock (CS) represents a higher cardiovascular risk, and revascularization strategy in such patients remains a subject of conflict.

Objectives: This work investigated total revascularization benefits and safety compared to culprit-only revascularization in ACS, MVD, and CS patients.

Patients and methods: This prospective randomized study was performed on 130 patients, aged ≥ 18 years old, both sexes, with ACS with MVD and CS and diagnosed with significant lesions (>70% stenosis in the major coronary vessel) in one or more coronary vessels. Patients were grouped into two equal groups: patients undergoing culprit revascularization in Group CR and those undergoing total revascularization in Group TR.

Results: Procedure time, the number of stents and contrast used, and left ventricular ejection fraction were significantly increased in group TR compared with group CR (P <0.001). Cardiac mortality in hospitals, at 1m, 6m, and 1y, were insignificantly different between groups. Repeat myocardial infraction (MI) /ACS at 1m, 6m, and 1y were comparable between both groups. All cause mortality, repeat MI /ACS, and revascularization at 1y were significantly decreased in group TR compared with group CR (P <0.05).

Conclusions: In ACS with MVD and CS, total revascularization is superior to culprit-only revascularization, as evidenced by better cardiac motility, lower all cause mortality, total repeat MI /ACS, and revascularization incidence.

Keywords: Acute coronary syndrome; Cardiogenic shock; Multivessel disease; Mortality; Revascularization.

DOI: 10.21608/SVUIJM.2025.340077.2033

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Received: 29 December,2024.

Revised: 8 January, 2025.

Accepted: 24 January, 2025.

Published: 22 February, 2025

Cite this article as Sherif Mohamed Hamada.(2025). Culprit Only versus Total Revascularization in Acute Coronary Syndrome Patients Presented with Cardiogenic Shock with Multivessel Disease. *SVU-International Journal of Medical Sciences*. Vol.8, Issue 1, pp: 444-451.

Introduction

Acute coronary syndrome (ACS) poses a serious threat to life and necessitates coronary revascularization. Percutaneous coronary intervention (PCI) is the gold standard procedure for revascularization, typically conducted at specialized cardiovascular centers. In severe ACS cases, cardiogenic shock (CS) can arise in 3-13% of patients, substantially elevating mortality risk by more than tenfold **(Surve et al., 2023;Elscot et al., 2024)**.

CS is characterized by insufficient oxygen delivery and hypoperfusion owing to severe cardiac dysfunction **(Laghlam et al., 2024)**. If left untreated, CS can rapidly lead to multiple organ failure and death. The presence of CS can be indicated by decreased systolic blood pressure (<90 mmHg), cardiac index (<2.2l/min/m^2), and increased pulmonary capillary wedge pressure ≥ 15 mmHg **(Thiele et al., 2019;Ehrenberger et al., 2023)**.

CS in ACS is a significant, high-mortality condition needs comprehensive therapy. Key interventions include prompt coronary reperfusion and hemodynamic support to improve survival. In severe but potentially reversible cases, mechanical circulatory assistance may be necessary to maintain organ perfusion and aid heart recovery **(Gill et al., 2022)**.

Multivessel disease (MVD) affects around 50% of ACS cases **(Faro et al., 2023)** and is associated with poor outcomes and high-mortality frequency. The pathophysiology of MVD, including the role of unstable plaques and inflammation, is still being actively researched better to understand its impact on patient outcomes in cardiovascular medicine **(Lemor et al., 2020;Elscot et al., 2023)**.

Recent studies have established the gains of total revascularization in hemodynamically stable ACS patients with MVD. Clinical guidelines provide evidence-based solid recommendations for ST-segment elevation MI (STEMI) management. At the same time, the evidence is less robust for non-STEMI (NSTEMI) and CS **(Paradies et al., 2021)**.

However, several areas of uncertainty remain, including total revascularization optimal timing and intermediate stenoses best-guiding approach, leading to ongoing controversy in the research community **(Voudris and Feldman, 2021;Jain et al., 2023)**. Thus, this work investigated total revascularization benefits and safety compared to culprit-only revascularization in ACS, MVD, and CS patients

Patients and methods

This prospective randomized study was performed on 130 patients, aged ≥ 18 years old, both sexes, with ACS with MVD and CS and diagnosed with significant lesions (>70% stenosis in a major coronary vessel) in one or more coronary vessels.

The research was conducted between July 2022 to June 2024 after approval from the Ethical Committee of Al-Azhar Assiut University Hospitals, Egypt. The patients provided informed written consent.

Exclusion criteria were renal dysfunction, unsuitable coronary anatomy, and previous coronary artery bypass grafting surgery (CABG).

Randomization: Computer-generated randomization numbers were used for random allocation, and each patient's code was kept in an opaque, sealed envelope. Patients were randomized and parallelly allocated into two equal groups with a 1:1 allocation ratio. Patients were grouped into two equal groups: those undergoing culprit revascularization in Group CR and those undergoing total revascularization in Group TR.

All patients underwent history taking, complete clinical examination, and laboratory and radiological investigations.

The TR Group underwent routine, staged PCI procedures to treat all suitable, non-culprit lesions, regardless of whether they were causing symptoms or not. In contrast, the CR Group received standard

medical therapy in accordance with guidelines, without any additional revascularization procedures, even if non-invasive tests indicated the presence of ischemia.

Follow-up assessments were conducted 1m, 6m, and 1y after the procedure, with data collected through a combination of scheduled clinical visits and telephonic communication with patients.

The primary outcome was cardiac mortality. The secondary outcomes were all causes mortality, repeat revascularization, in-hospital mortality, and complications

Statistical analysis

The statistical analysis was done using IBM's SPSS software V 27. To determine data distribution normality, the Shapiro-Wilks test and histograms were employed. The results of the parametric quantitative data are presented as mean and standard deviation (SD) and were analyzed using unpaired two-sample t-tests. The qualitative variables are presented as frequency and % and were analyzed using the chi-square test or Fisher's exact test when applicable. A statistically significant result was defined as a two-tailed P of less than 0.05.

Results

A total of 151 patients were initially assessed for eligibility, but 14 did not meet the criteria, and 7 refused to participate, and remaining 130 patients were randomized into two groups of 65 patients each. The patient population allocated to the study was thoroughly examined and statistically analyzed. (**Fig.1).**

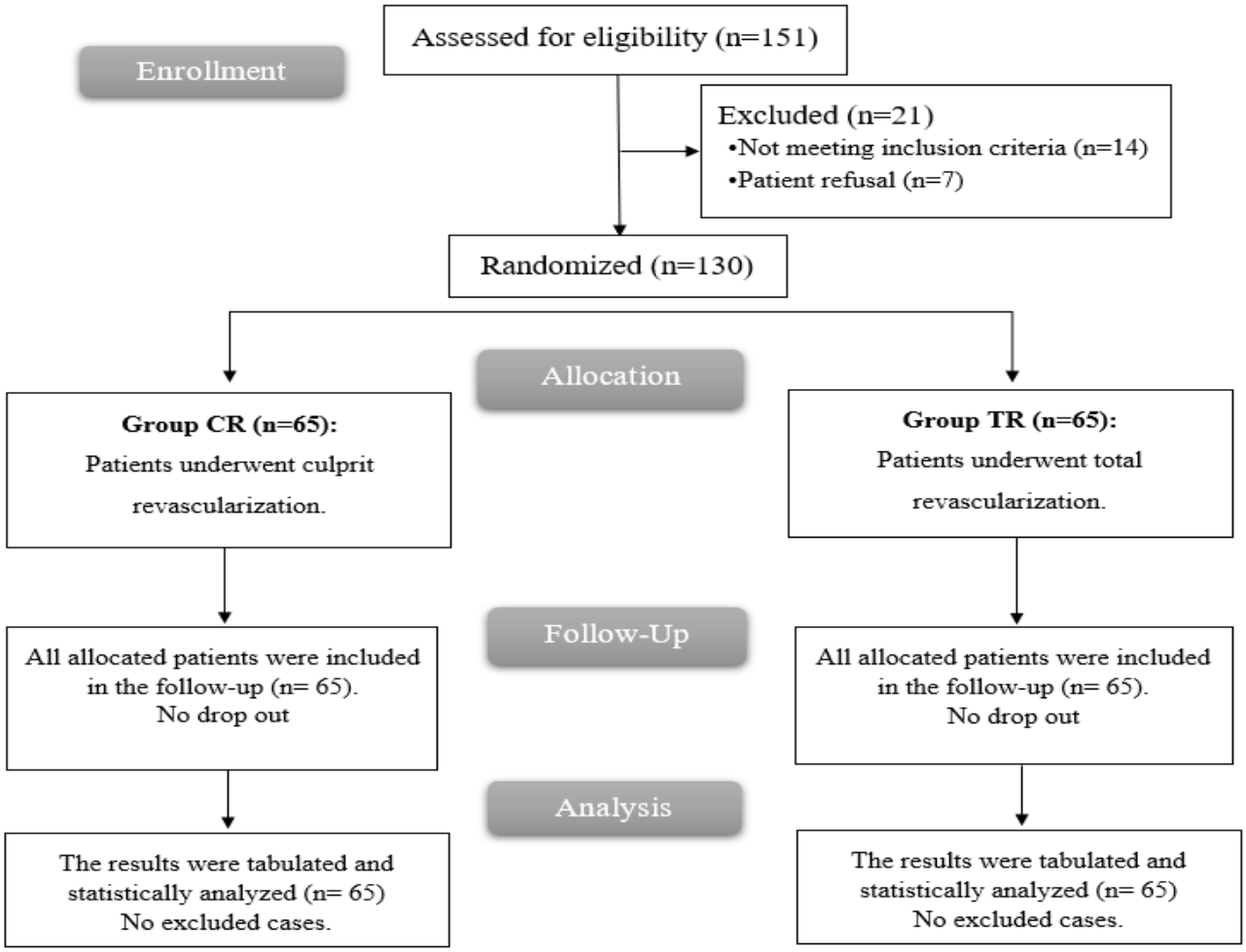

Fig. 1. CONSORT flowchart of the enrolled patients

The demographic data and comorbidities of the two groups were similar. The procedure time was significantly extended in the group TR than in the group CR (P <0.001). (**Table.1).**

Table 1. Demographic data, comorbidities, and procedure time of the studied groups

Variables		Group CR (n=65)	Group TR (n=65)	P
Age (years)		48.62 ± 13.95	49.75 ± 17.41	0.681
Sex	**Male**	47 (72.31%)	43 (66.15%)	0.447
	Female	18 (27.69%)	22 (33.85%)	
Weight (kg)		82.02 ± 12.97	79.58 ± 10.74	0.247
Height (m)		1.67 ± 0.08	1.68 ± 0.06	0.757
BMI (kg/m^2)		29.57 ± 5.78	28.43 ± 4.32	0.205
Comorbidities	**DM**	27 (41.54%)	24 (36.92%)	0.590
	Hypertension	38 (58.46%)	43 (66.15%)	0.366
	Smoking	34 (52.31%)	36 (55.38%)	0.725
	Dyslipidaemia	27 (41.54%)	20 (30.77%)	0.201
Procedure time (min)		40.77 ± 8.76	59.08 ± 11.21	**<0.001***

Data are presented as mean ± SD or frequency (%). BMI: Body mass index, DM: Diabetes mellitus. *: significant as p < 0.05.

AWMI, IWMI, KILLIP class, arteries with stenosis, and window period of the two groups were comparable. Stents number and contrast used were significantly elevated in group TR than in group CR (P <0.001). **(Table.2).**

Table 2. Clinical presentation and procedural outcomes of the studied groups

Variables		Group CR (n=65)	Group TR (n=65)	P
AWMI		25 (38.46%)	35 (53.85%)	0.079
IWMI		40 (61.54%)	31 (47.69%)	0.113
KILLIP class	**I**	45 (69.23%)	41 (63.08%)	0.734
	II	18 (27.69%)	21 (32.31%)	
	III	2 (3.08%)	3 (4.62%)	
Arteries with stenosis (%)		2.28 ± 0.6	2.14 ± 0.7	0.230
Window period (hours)		5.49 ± 2.43	5.75 ± 2.55	0.551
Number of stents		1.42 ± 0.5	2.48 ± 1.13	**<0.001***
Contrast used (ml)		108.09 ± 21.08	163.42 ± 21.15	**<0.001***

Data are presented as mean ± SD or frequency (%). AWMI: Anterior wall myocardial infarction, IWMI: Inferior wall myocardial infarction. *: significant as p < 0.05.

There were no notable disparities seen between the two groups in left ventricular ejection fraction (LVEF %) at discharge and one month, but LVEF % at six months and one year were significantly elevated in group TR group than group CR (P <0.001). (**Table.3).**

Table 3. LVEF (%) of the studied groups

Variables	Group CR (n=65)	Group TR (n=65)	P value
At discharge	40.38 ± 6.61	39.23 ± 7.71	0.367
At 1m	41.95 ± 6.44	40.97 ± 7.79	0.448
At 6m	46.32 ± 6.57	52.3 ± 8.4	**<0.001***
At 1y	47.66 ± 6.6	55.32 ± 8.69	**<0.001***

Data are presented as mean ± SD. LVEF: Left ventricular ejection fraction. *: significant as p < 0.05.

Cardiac mortality in hospitals, at 1m, 6m, and 1y, was similar between the two groups, as was the rate of repeat MI/ACS. However, at one year, the all cause mortality, total repeat MI/ACS, and revascularization rates were significantly decreased in group TR than in group CR (P <0.05). (**Table.4).**

Table 4. All cause mortality, repeat MI /ACS, and revascularization at 1y of the studied groups

Variables		Group CR (n=65)	Group TR (n=65)	P value
Cardiac mortality	**In hospital**	2 (3.08%)	0 (0%)	0.496
	At 1m	3 (4.62%)	1 (1.54%)	0.619
	At 6m	4 (6.15%)	1 (1.54%)	0.365
	At 1y	6 (9.23%)	1 (1.54%)	0.061
	All cause mortality	15 (23.08%)	3 (4.62%)	**0.004***
Repeat MI /ACS	**At 1m**	5 (7.69%)	2 (3.08%)	0.440
	At 6m	2 (3.08%)	0 (0%)	0.496
	At 1y	3 (4.62%)	0 (0%)	0.244
	Total repeat MI /ACS	10 (15.38%)	2 (3.08%)	**0.030***
Revascularization at 1y		21 (32.31%)	4 (6.15%)	**<0.001***

Data are presented as mean ± SD. MI: Myocardial infarction, ACS: Acute coronary syndrome. *: significant as $p < 0.05$.

Discussion

In our study procedure time, number of stents, and contrast used, LVEF % at 6m and 1y was significantly elevated in Group TR than in Group CR. Cardiac mortality in hospital and repeat MI /ACS at 1m, 6m, and 1y were insignificantly different between both groups. All cause mortality, total repeat MI /ACS, and revascularization at 1y significantly decreased in group TR compared to group CR.

In agreement with our results, Maqsood et al. **(Maqsood et al., 2024)** stated that both single-setting total revascularization and staged total revascularization strategies exhibited a reduced risk of cardiovascular mortality or MI, risk of all-cause mortality or MI, and a lower likelihood of requiring repeat revascularization when than in the culprit-only PCI.

Choi et al. **(Choi et al., 2023)** agreed with our results and observed that patients presenting with acute MI and CS who underwent veno-arterial extracorporeal membrane oxygenation before revascularization demonstrated significantly diminished risks of 30-day mortality or the requirement for renal replacement therapy and all-cause mortality through the 12-month follow-up period when subjected to immediate MVD PCI, in contrast to the culprit only PCI.

Also, Pustjens et al. **(Pustjens et al., 2022)**. stated that fewer coronary reinterventions were noted in group TR than in group CR. Rathod et al. **(Rathod et al., 2018)**. study came in line with our results and demonstrated that a significantly reduced mortality risk was noted in group TR than in group CR. Additionally, Kim et al. **(Kim et al., 2011)**. found a significant decline in all-cause cardiac mortality, total repeat MI /ACS and revascularization in group TR compared to group CR.

Moreover, Jang et al. **(Jang et al., 2015)**. illustrated that multivessel-PCI was associated with a significant decline in repeat revascularization rate. However, they did not observe a significant difference regarding all-cause mortality or MI rates between their groups. The difference in results could be attributed to the larger sample size in their study, which included 8,425 patients. In contrast with our results, Musallam et al. **(Musallam et al., 2024)**. reported that all causes mortality were comparable between both

groups. This difference can be attributed to CS patients were excluded from their study.

A meta-analysis conducted by Quao and colleagues **(Qiao et al., 2015)**. found that, in the long term, the risk of MI and mortality was comparable between multivessel-PCI and culprit-only PCI. This difference may be because their different inclusion criteria as their assess PCI (multivessel and culprit-only) in NSTEMI-ACS cases.

The findings' generalizability to other patient populations or surgical contexts may be restricted by the fact that the relatively small sample size and the study was performed in a single setting facility. The study did not include patients with renal dysfunction, unsuitable coronary anatomy, or previous CABG, which may exclude a significant portion of the population with ACS and MVD. The exclusion of these patients may also limit the applicability of the results to the broader population with ACS and MVD. The study relied on subjective measures such as cardiac motility, which may introduce bias. The use of telephonic communication for follow-up assessments may also result in incomplete or inaccurate data collection. The study did not assess other important outcomes such as quality of life, functional status, or patient satisfaction.

Conclusions

In ACS with MVD and cardiogenic shock, total revascularization is superior to culprit-only revascularization, as evidenced by better cardiac motility, lower all cause mortality, total repeat MI /ACS, and revascularization incidence.

Financial support and sponsorship: Nil

Conflict of Interest: Nil

References

- **Choi KH, Yang JH, Park TK, Lee JM, Song YB, Hahn JY, et al. (2023)**. Culprit only versus immediate multivessel percutaneous coronary intervention in patients with acute myocardial infarction complicating advanced cardiogenic shock requiring venoarterial‐extracorporeal membrane oxygenation. Journal of the American Heart Association, 15 (10): 5-10.
- **Ehrenberger R, Németh BT, Kulyassa P, Fülöp GA, Becker D, Kiss B, et al. (2023)**. Acute coronary syndrome associated cardiogenic shock in the catheterization laboratory: peripheral veno-arterial extracorporeal membrane oxygenator management and recommendations. Frontiers in medicine, 10 (4): 127-504.
- **Elscot JJ, Kakar H, Scarparo P, Dekker WKd, Bennett J, Schotborgh CE, et al. (2023)**. Timing of complete multivessel revascularization in patients presenting with non-ST-elevation acute coronary syndrome. medRxiv, 12 (4): 78-98.
- **Elscot JJ, Kakar H, Scarparo P, den Dekker WK, Bennett J, Schotborgh CE, et al. (2024)**. Timing of complete multivessel revascularization in patients presenting with non-ST-segment elevation acute coronary syndrome. Cardiovascular interventions, 17 (6): 771-82.
- **Faro DC, Laudani C, Agnello FG, Ammirabile N, Finocchiaro S, Legnazzi M, et al. (2023)**. Complete percutaneous coronary revascularization in acute coronary syndromes with multivessel coronary disease: A systematic review. Cardiovascular interventions, 16 (19): 2347-4.
- **Gill GS, Sánchez JS, Thandra A, Kanmanthareddy A, Alla VM & Garcia-Garcia HM (2022)**. Multivessel vs. culprit-vessel only percutaneous coronary interventions in acute myocardial infarction and cardiogenic shock: a systematic review and meta-analysis of prospective randomized and

retrospective studies. European Heart Journal - Acute Cardiovascular Care, 11 (7): 558-69.

- **Jain C, Dash P, Iyer V & Deshmukh R (2023)**. Culprit vessel only versus complete revascularization following thrombolysis in patients with ST elevation myocardial infraction and multivessel coronary artery disease-A prospective study. Indian Heart Journal, 75 (4): 274-8.
- **Jang JS, Jin HY, Seo JS, Yang TH, Kim DK, Kim DS, et al. (2015)**. Meta-analysis of multivessel versus culprit-only percutaneous coronary intervention in patients with non-ST-segment elevation acute coronary syndrome and multivessel coronary disease. The American Journal of Cardiology, 115 (8): 1027-32.
- **Kim MC, Jeong MH, Ahn Y, Kim JH, Chae SC, Kim YJ, et al. (2011)**. What is optimal revascularization strategy in patients with multivessel coronary artery disease in non-ST-elevation myocardial infarction? Multivessel or culprit-only revascularization. International journal of cardiology, 153 (2): 148-53.
- **Laghlam D, Benghanem S, Ortuno S, Bouabdallaoui N, Manzo-Silberman S, Hamzaoui O, et al. (2024)**. Management of cardiogenic shock: a narrative review. Annals of intensive care, 14 (1): 45-60.
- **Lemor A, Basir MB, Patel K, Kolski B, Kaki A, Kapur NK, et al. (2020)**. Multivessel versus culprit-vessel percutaneous coronary intervention in cardiogenic shock. Cardiovascular interventions, 13 (10): 1171-8.
- **Maqsood MH, Tamis-Holland JE, Rao SV, Stone GW & Bangalore S (2024)**. Culprit-only revascularization, single-setting complete revascularization, and staged complete revascularization in acute myocardial infarction: Insights from a mixed treatment comparison meta-analysis of randomized trials. Cardiovascular interventions, 17 (7): 12-25.
- **Musallam A, Elrabbat K, Tabl MA & Allam HI (2024)**. Complete versus culprit-only revascularization strategies to treat multivessel disease after primary percutaneous coronary intervention for ST elevation myocardial infarction. Benha Medical Journal, 18 (5): 12-8.
- **Paradies V, Waldeyer C, Laforgia PL, Clemmensen P & Smits PC (2021)**. Completeness of revascularisation in acute coronary syndrome patients with multivessel disease. EuroIntervention, 17 (3): 193-201.
- **Pustjens TFS, Timmermans MJC, Rasoul S, van 't Hof AWJ, On Behalf Of The Pci Registration C & The Cardiothoracic Surgery Registration Committee Of The Netherlands Heart R (2022)**. Multivessel versus culprit-only percutaneous coronary intervention in patients with non-ST-elevation acute coronary syndrome. Journal of clinical medicine, 110 (20): 12-4.
- **Qiao Y, Li W, Mohamed S, Nie S, Du X, Zhang Y, et al. (2015)**. A comparison of multivessel and culprit vessel percutaneous coronary intervention in non-ST-segment elevation acute coronary syndrome patients with multivessel disease: a meta-analysis. EuroIntervention, 11 (5): 525-32.
- **Rathod KS, Koganti S, Jain AK, Astroulakis Z, Lim P, Rakhit R, et al. (2018)**. Complete versus culprit-only lesion intervention in patients with acute coronary syndromes. Journals of the American College of Cardiology, 72 (17): 1989-99.
- **Surve TA, Kazim MA, Sughra M, Mirza AMW, Murugan SK, Shebani KA, et al. (2023)**.

Revascularization modalities in acute coronary syndrome: A review of the current state of evidence. Cureus, 15 (10): 55-9.

- **Thiele H, Ohman EM, de Waha-Thiele S, Zeymer U & Desch S (2019)**. Management of cardiogenic shock complicating myocardial infarction: an update 2019. European heart journal, 40 (32): 2671-83.
- **Voudris KV & Feldman DN (2021)**. Complete revascularization in patients with STEMI and multivessel coronary artery disease: is it beneficial? Current treatment options in cardiovascular medicine, 23 (5): 1-12.