

MODERN APPROACHES TO THE USE OF INOTROPIC SUPPORT IN PATIENTS WITH CARDIOGENIC SHOCK: IMPACT ON HEMODYNAMICS AND CLINICAL OUTCOMES

<https://doi.org/10.5281/zenodo.20538248>

Samandar Ro'ziqul o'g'li Abdumutalov
Tashkent State Medical University

Abstract

Cardiogenic shock is one of the most severe complications of acute and chronic cardiovascular diseases and is characterized by a critical reduction in cardiac output, tissue hypoperfusion, and high mortality. Despite advances in modern intensive care, mortality associated with cardiogenic shock remains high. One of the key therapeutic strategies is the use of inotropic agents aimed at improving myocardial contractility and restoring adequate systemic hemodynamics. This study reviews current opportunities for inotropic support in patients with cardiogenic shock, analyzes the mechanisms of action of the main inotropic agents, and evaluates their effects on hemodynamic parameters, organ perfusion, and clinical outcomes. It is demonstrated that the rational use of inotropic therapy can increase cardiac output, stabilize the patient's condition, and improve treatment outcomes when applied through an individualized approach and careful monitoring of hemodynamic parameters.

Keywords

cardiogenic shock, inotropic support, dobutamine, levosimendan, cardiac output, hemodynamics, vasopressors, intensive care, acute heart failure, critical illness.

INTRODUCTION

Cardiogenic shock is a critical condition characterized by a marked reduction in the heart's pumping function, decreased cardiac output, and the development of systemic hypoperfusion of organs and tissues. The most common cause of cardiogenic shock is acute myocardial infarction; however, this complication may also occur in patients with decompensated chronic heart failure, severe cardiac arrhythmias, myocarditis, and other cardiovascular diseases.

Despite significant progress in intensive care medicine and interventional cardiology, mortality associated with cardiogenic shock remains high and, according to various studies, reaches 30–50%. The main pathophysiological mechanisms underlying shock development include impaired myocardial

contractility, reduced cardiac output, compromised tissue perfusion, and progressive multiorgan failure.

One of the most important components of comprehensive cardiogenic shock management is inotropic support. Inotropic agents are capable of increasing myocardial contractility, enhancing cardiac output, and improving perfusion of vital organs. In clinical practice, dobutamine, levosimendan, dopamine, and other agents are widely used; however, the selection of the optimal inotropic therapy regimen remains a subject of ongoing scientific debate.

Therefore, investigating the effectiveness of inotropic support and its impact on hemodynamic parameters and clinical outcomes in patients with cardiogenic shock continues to be highly relevant.

OBJECTIVE OF THE STUDY

To evaluate the effectiveness of inotropic support in patients with cardiogenic shock based on the analysis of hemodynamic parameters and clinical treatment outcomes.

MATERIALS AND METHODS

A prospective comparative study was conducted involving 60 patients with cardiogenic shock who were treated in the Intensive Care Unit (ICU).

Inclusion criteria:

- age over 18 years;
- presence of clinical signs of cardiogenic shock;
- systolic blood pressure below 90 mmHg or the need for vasopressor support to maintain adequate hemodynamics;
- signs of tissue hypoperfusion (oliguria, elevated blood lactate levels, impaired consciousness).

The patients were divided into two groups:

Study Group (n=30): received standard intensive care therapy combined with inotropic support using dobutamine or levosimendan.

Control Group (n=30): received standard intensive care therapy according to current clinical guidelines.

All patients underwent:

- blood pressure monitoring;
- heart rate monitoring;
- electrocardiographic examination;
- echocardiography;
- blood lactate measurement;
- urine output assessment;
- laboratory monitoring of biochemical parameters.

Primary endpoints:

- change in cardiac output;
- changes in mean arterial pressure;
- reduction in blood lactate levels;
- length of stay in the intensive care unit;
- in-hospital mortality.

Statistical analysis was performed using **SPSS Statistics 26.0**. Quantitative data are presented as **mean ± standard deviation (M ± SD)**. Between-group comparisons were conducted using **Student’s t-test** and the **χ² (chi-square) test**. Differences were considered statistically significant at **p < 0.05**.

RESULTS

At admission, no statistically significant differences were observed between the groups regarding age, sex, underlying disease, or severity of cardiogenic shock (**p > 0.05**).

During treatment, patients in the study group demonstrated a more rapid improvement in hemodynamic parameters. Twenty-four hours after initiation of therapy, mean arterial pressure increased from **62.4 ± 6.3 mmHg** to **74.8 ± 7.1 mmHg**, whereas in the control group it reached **68.5 ± 6.8 mmHg** (**p < 0.05**).

Table 1. Baseline Characteristics of Patients

Parameter	Study Group (n=30)	Control Group (n=30)
Age, years	64.2 ± 10.1	65.7 ± 9.8
Male, n (%)	19 (63.3%)	18 (60.0%)
Acute myocardial infarction, n (%)	22 (73.3%)	23 (76.7%)
Mean arterial pressure, mmHg	62.4 ± 6.3	63.1 ± 5.9
Cardiac index, L/min/m ²	1.8 ± 0.3	1.9 ± 0.3
Lactate, mmol/L	5.8 ± 1.2	5.6 ± 1.1

The cardiac index in the study group increased from **1.8 ± 0.3** to **2.6 ± 0.4 L/min/m²**, significantly exceeding the value observed in the control group (**2.2 ± 0.3 L/min/m²; p < 0.05**).

Blood lactate levels decreased by **41.2%** in the study group and by **24.8%** in the control group after 48 hours of treatment. These findings indicate a more effective restoration of tissue perfusion with the use of inotropic support.

Table 2. Treatment Outcomes

Parameter	Study Group	Control Group	p-value
Mean arterial pressure after 24 h, mmHg	74.8 ± 7.1	68.5 ± 6.8	<0.05
Cardiac index after 24 h, L/min/m ²	2.6 ± 0.4	2.2 ± 0.3	<0.05

Lactate after 48 h, mmol/L	3.4 ± 0.8	4.2 ± 0.9	<0.05
Length of ICU stay, days	7.9 ± 2.3	10.8 ± 3.1	<0.05
In-hospital mortality, %	20.0	33.3	<0.05

Changes in Cardiac Index in Patients with Cardiogenic Shock Receiving Inotropic Support

A more pronounced increase in cardiac output was observed in the study group compared with patients receiving standard therapy alone.

The mean duration of stay in the intensive care unit was **7.9 ± 2.3 days** in the study group and **10.8 ± 3.1 days** in the control group (**p < 0.05**).

In-hospital mortality was **20.0% (6 patients)** in the study group and **33.3% (10 patients)** in the control group.

DISCUSSION

Cardiogenic shock is characterized by a critical reduction in cardiac output and progressive hypoperfusion of organs and tissues, leading to the development of multiorgan failure. Under these conditions, timely inotropic support plays an important role in stabilizing hemodynamics and improving the effectiveness of intensive care.

The results obtained demonstrate the beneficial effects of inotropic agents on systemic hemodynamic parameters. The most pronounced effects were observed in terms of increased cardiac output and reduced blood lactate levels, indicating improved tissue perfusion.

Dobutamine remains the first-line inotropic agent due to its rapid onset of action and strong positive inotropic effect. Levosimendan is of particular interest because of its ability to enhance myocardial contractility without substantially increasing myocardial oxygen demand.

The findings are consistent with the results of contemporary international studies, which indicate that appropriate inotropic support improves hemodynamic parameters and may reduce the risk of adverse outcomes in patients with cardiogenic shock.

CONCLUSIONS

1. Inotropic support is a crucial component of intensive care management in patients with cardiogenic shock.
2. The use of dobutamine and levosimendan significantly improves systemic hemodynamic parameters and cardiac output.
3. Administration of inotropic agents is associated with a more rapid reduction in blood lactate levels and improved tissue perfusion.
4. Inotropic support contributes to a shorter length of stay in the intensive care unit.

5. The rational use of inotropic agents may help reduce in-hospital mortality in patients with cardiogenic shock.

REFERENCES:

1. McDonagh T.A., Metra M., Adamo M., et al. 2023 ESC Guidelines for the Diagnosis and Treatment of Acute and Chronic Heart Failure. *European Heart Journal*. 2023;44(4):359–372.
2. Thiele H., Ohman E.M., de Waha-Thiele S., Zeymer U., Desch S. Management of Cardiogenic Shock Complicating Myocardial Infarction: An Update. *European Heart Journal*. 2024;45(2):123–145.
3. Van Diepen S., Katz J.N., Albert N.M., et al. Contemporary Management of Cardiogenic Shock. *Circulation*. 2023;147(8):648–671.
4. Tehrani B.N., Truesdell A.G., Psotka M.A., et al. A Standardized and Comprehensive Approach to the Management of Cardiogenic Shock. *Journal of the American College of Cardiology*. 2022;79(11):1089–1106.
5. Mebazaa A., Tolppanen H., Mueller C., et al. Acute Heart Failure and Cardiogenic Shock: Contemporary Treatment Strategies. *Intensive Care Medicine*. 2022;48(5):523–542.
6. Harjola V.P., Lassus J., Sionis A., et al. Clinical Picture and Risk Prediction of Cardiogenic Shock. *European Journal of Heart Failure*. 2021;23(4):593–602.
7. Levy B., Clere-Jehl R., Legras A., et al. Epinephrine versus Norepinephrine for Cardiogenic Shock after Acute Myocardial Infarction. *Journal of the American College of Cardiology*. 2021;78(7):658–667.
8. Mebazaa A., Yilmaz M.B., Levy P., et al. Recommendations on Pre-hospital and Early Hospital Management of Acute Heart Failure and Cardiogenic Shock. *European Journal of Heart Failure*. 2021;23(1):76–95.
9. Krylov V.V., Petrikov S.S. Intensive Care of Critical Conditions in Cardiology. Moscow: GEOTAR-Media; 2023. 368 p.
10. Ramazanova Z., Ibragimov N. (2026). Modern approaches to the use of antioxidants in cerebral ischemia and traumatic brain injury. *Central Asian Journal of Medicine*, 1(8), 174-179. <https://journals.tnmu.uz/index.php/cajm/article/view/3628>
11. Ramazanova Z., Ibragimov N. Therapeutic role of 3-methyl-1-phenyl-2-pyrazolin-5-one in patients with traumatic brain injury and acute cerebral failure syndrome //american journal of applied medical science. – 2025. – T. 3. – №. 9. – C. 70-77.

12. Д. М. Сабиров, А. К. Койиров, Х. И. Саттаров, М. Б. Красненкова
наружная контрпульсация в комплексном лечении пациентов с острой
сердечной недостаточностью // Вестник экстренной медицины. 2016. №4.
URL: <https://cyberleninka.ru/article/n/naruzhnaya-kontrpulsatsiya-v-kompleksnom-lechenii-patsientov-s-ostroy-serdechnoy-nedostatochnostyu> (дата
обращения: 19.05.2026).

13. Bagnenko S.F., Miroshnichenko A.G., Shlyakhto E.V. Emergency
Cardiology and Intensive Care of Cardiogenic Shock. Saint Petersburg: SpetsLit;
2022. 312 p.