E-ISSN: 3078-4514
P-ISSN: 3105-1316
Vol. 2, No. 1, 2025
DOI: 10.71295/JHDT.2025.020102

J-HDT.COM

RESEARCH ARTICLE

Study of the Effect of Magnesium Preparations on Physical Tolerance in Patients with Chronic Coronary Syndrome

Rufulla Abdullayev[1], Aytan Quliyeva[1*], Rufana Abdullayeva[2], Mahluqa İsayeva[1], Saida Muradova[1], Irada Abdullayeva[1]

[1]*Scientific-Research Institute of Cardiology named after C.M. Abdullayev.*

[2]*Military Hospital of the Main Medical Department of the Ministry of Defense. Baku, Azerbaijan*

Corresponding Author: *Zaur Gasimov, Email: gasimovzaur1963@gmail.com*

Received: 15/05/2025 **Revised:** 20/05/2025 **Accepted:** 20/05/2025

Abstract

The main purpose of this study was to investigate the effect of magnesium preparations on physical tolerance in patients with stable angina pectoris. For this purpose, patients receiving basic antianginal therapy were divided into two groups. The main group's treatment included traditional antianginal drugs along with a magnesium preparation. The control group received only traditional antianginal therapy. The 12-week treatment demonstrated that, in patients of the main group receiving magnesium preparations, most indicators of physical tolerance were higher compared to the control group, leading to a greater antianginal effect.

Keywords: Chronic coronary syndrome, Magnesium.

Relevance

Currently, one of the primary issues attracting researchers' attention is the disturbance of electrolyte balance, including magnesium metabolism, during cardiovascular diseases [1,2,3]. Consequently, there has been increased interest in studying the biological role of magnesium and its participation in the etiology and pathogenesis of various cardiovascular diseases [4].

According to various authors, magnesium deficiency is observed in 20-40% of the world population [5,6]. Specifically, in Russia, this figure reaches 47.8%, and in Poland, 46%. Magnesium deficiency, considered the natural antagonist of calcium, plays a significant role in the development of several cardiovascular diseases, including arterial hypertension [9], arrhythmias [10], ischemic heart disease [11], thromboses [12], myocardial infarction [13], heart failure, sudden death [14], and other organ and system pathologies [15,16].

It should be noted that the impact of magnesium deficiency on the clinical course of chronic coronary syndrome has not been fully studied. Literature on the interaction between magnesium levels in blood and stable angina pectoris is quite rare [16].

The study of the effect of magnesium preparations on physical tolerance in patients with chronic coronary syndrome, against the background of traditional antianginal therapy, is of particular interest.

Purpose of the Study

The aim was to investigate the effect of magnesium preparations on physical tolerance in patients with stable angina pectoris.

Materials and Methods

The study included 42 patients with II-III functional class (FC) stable angina pectoris (mean age 52.4 ± 2.2 years). Prior to the examination, these patients received basic antianginal therapy. The treatment regimen included β-adrenoblockers, antithrombotic agents, statins, angiotensin-converting enzyme inhibitors, and nitrates as needed.

All patients were randomized into 2 groups. The first group (main group) consisted of 22 patients with ischemic heart disease (IHD), who received magnesium preparations (Magnerot) in addition to basic antianginal therapy. The second group (control group) included 20 patients who only received basic antianginal medications. Before treatment, all patients underwent a treadmill test. After 12 weeks of treatment with Magnerot, a second treadmill test was performed. The results were compared. The following indicators were analyzed: heart rate (HR), duration of exertion, ST segment depression, time until ST segment

Table 1: Dynamics of treadmill test indicators after magnesium treatment

Tolerance Indicators	*Main Group (n=22)*	*Control Group (n=20)*	*Significance*
1. Duration of exertion (sec)	311 ± 22 → 445 ± 35 ** (p <0.01)	318 ± 25 → 429 ± 28 (p <0.05)	<0.01
2. Heart rate (bpm)	130 ± 6.2 → 145 ± 7.3 (p <0.05)	132 ± 4.2 → 142 ± 6.1 (p <0.05)	>0.05
3. ST segment depression (mm)	2.4 ± 0.3 → 0.9 ± 0.2 * (p <0.05)	2.3 ± 0.2 → 1.1 ± 0.1 (p <0.05)	<0.05
4. Time until ST depression (sec)	328 ± 28 → 430 ± 36 * (p <0.05)	325 ± 20 → 415 ± 25 (p <0.05)	<0.05
5. Time until ST recovery (sec)	398 ± 29 → 310 ± 32 * (p <0.05)	394 ± 34 → 388 ± 42 (p <0.05)	<0.05
6. Double product (DP)	192 ± 7.8 → 212 ± 9.0 (p>0.05)	195 ± 5.5 → 235 ± 8.5 * (p <0.05)	<0.05
7. Metabolic equivalent (MET)	4.8 ± 0.4 → 6.5 ± 0.6 * (p <0.05)	4.6 ± 0.3 → 5.7 ± 0.3 (p <0.05)	<0.05

Note: Significant difference between groups after treatment *(p <0.05); ** p <0.01.

depression, time until ST segment recovery, double product (DP), and metabolic equivalent (MET).

The treadmill test was conducted using the Carello Stress Test RHC 500 device according to Bruce's protocol (up to submaximal exertion). Magnerot (produced by Worwaq Pharma, Germany) was prescribed as follows: 2 tablets per day in the first week, then 1 tablet three times daily for the next 11 weeks.

Results and Discussion

The results are summarized in the table below. It was observed that in the main group receiving Magnerot, the duration of exertion increased from 311 ± 22 seconds to 445 ± 35 seconds (p <0.01), and the heart rate (HR) increased from 130 ± 6.2 to 145 ± 7.3 bpm (p <0.05) compared to the first treadmill test. In the control group, after 12 weeks, the exertion duration increased from 318 ± 25 to 429 ± 28 seconds (p <0.05), and HR from 132 ± 4.2 to 142 ± 6.1 bpm (p <0.05). However, detailed analysis showed that the relative increase in exertion duration after the second test was 43% in the main group versus 35% in the control group. Regarding HR, the increase was 35% in the main group and only 7.6% in the control group.

As seen from the figure, the depression of the ST segment decreased from 2.4 ± 0.3 mm to 0.9 ± 0.2 mm (p <0.05) in the main group, representing a 62% reduction. In the control group, this indicator decreased from 2.3 ± 0.2 mm to 1.1 ± 0.1 mm (p <0.05), a 52% reduction. Although these parameters have statistically significant changesl in both groups, the degree of improvement was more pronounced in the main group receiving magnesium.

Dynamics of treadmill test indicators after magnesium treatment (Table 1)

In the main group, the period until ST depression occurred increased from 328 ± 28 seconds to 430 ± 36 seconds (p <0.05), a 31.1% increase. In the control group, it increased from 325 ± 20 seconds to 415 ± 25 seconds (p <0.05), a 27.7% increase. The time until ST segment recovery decreased from 398 ± 29 seconds to 310 ± 32 seconds (p <0.05) in the main group, a 22.1% reduction, and from 394 ± 34 to 338 ± 42 seconds in the control group, a 14.2% reduction. These positive changes were more pronounced in the main group.

The analysis of oxygen reserve indicators, double product (DP), and metabolic equivalent (MET), showed that at the start, the main group had DP of 192 ± 7.8 and MET of 4.8 ± 0.4. After treatment, DP increased to 212 ± 9.0 (not statistically significant, p>0.05), and MET increased to 6.5 ± 0.6 (p <0.05), a 35.4% increase. In the control group, DP increased from 195 ± 5.5 to 235 ± 8.5 (p <0.05), and MET from 4.6 ± 0.3 to 5.7 ± 0.3 (p <0.05), a 24% increase.

Comparison of the results after 12 weeks of magnesium treatment shows that the total exertion duration during the second treadmill test was higher in the main group (445 ± 35 seconds) than in the control group (429 ± 28 seconds, p <0.05). The period until ST depression was also longer in the main group (430 ± 36 seconds) than in the control group (415 ± 25 seconds, p <0.05). The duration until ST recovery and the other parameters followed a similar trend, indicating a more significant improvement in the main group.

Currently, there is evidence supporting the use of magnesium preparations in cardiology [18,19,20]. However, studies on the effect of magnesium on physical tolerance are limited. The role of magnesium, as a microelement involved in metabolic, physiological, and biochemical processes that form the basis of atherogenesis, including reducing vascular tone, anti-edema effects, endothelial-dependent vasodilation, normalization of lipid spectrum, and stabilization of cardiomyocyte membranes, justifies the application of magnesium preparations in patients with chronic coronary syndrome.

Conclusion

- Adding magnesium preparations to basic therapy in patients with stable angina pectoris statistically significantly improves their physical tolerance indicators.
- Magnerot results in a relatively smaller increase in heart rate and blood pressure compared to the control group,

leading to a statistically significant reduction in the double product indicator.

• Magnerot can be successfully used as a cardioprotective agent in clinical practice for patients with both stable and vasospastic angina.

References

1. Trisvetova E.L. Magnesium deficiency and cardiovascular diseases: time to act // Rational Pharmacotherapy in Cardiology, 2014, Vol. 10, No. 1, pp. 99-105
2. Cruber U., Schmidt J., Kisters K. Magnesium in Prevention and Therapy // Nutrients, 2015, Vol. 7, No. 9, pp. 8199-8226
3. Kolte D., Vijayaraghavan K., Khera S., et al. Role of magnesium in cardiovascular diseases // Cardiology Review, 2014, Vol. 22, No. 4, pp. 182-192
4. Torshin I.Y., Gromova O.A. Magnesium: fundamental studies and clinical practice. Nova Biomedical Publishers, NY, 2011.
5. Fox C.H., Ramsoomair D., Mahoney M.C., et al. An investigation of hypomagnesemia among ambulatory urban African Americans // Journal of Family Practice, 1999, Vol. 48, pp. 636-639
6. Shimatschek H.F. Prevalence of hypomagnesemia in an unselected German population of 16,000 individuals // Magnesium Research, 2001, Vol. 14, pp. 283-290
7. Gromova O.A., Torshin I.Y., Rudakov K.V., et al. Magnesium deficiency – a reliable risk factor for comorbid conditions: results of large-scale screening of magnesium status in Russian regions // Farmateka, 2013, No. 6, pp. 116-129
8. Ceremuzynski L., Gebalska J., Wolk R., Makowska E. Hypomagnesemia in heart failure with ventricular arrhythmias. Beneficial effects of magnesium supplementation. // Journal of Internal Medicine, 2000, Vol. 247, pp. 78-86
9. Gromova O.A., Torshin I.Y., Yudina N.V., et al. Magnesium deficiency and regulation disturbances of vascular tone // Cardiology, 2014, No. 7, pp. 66-72
10. Nechaeva G.M., Yakovlev V.M., Druk I.V., Tikhonova O.V. Heart rhythm disturbances in undifferentiated connective tissue dysplasia // Attending Physician, 2008, No. 6, pp. 2-7
11. Ezhov A.V., Pimenov L.T., Makarova M.I., et al. Magnesium exchange and clinical-functional characteristics in patients with stable ischemic heart disease // Rational Pharmacotherapy in Cardiology, 2010, Vol. 6, No. 4, pp. 461-468
12. Gromova O.A., Torshin I.Y., Tetrashvili N.K., Rudakov K.V. Magnesium and pregnancy thrombophilia: molecular mechanisms and evidence-based medicine // Russian Obstetrics and Gynecology Bulletin, 2009, No. 6, pp. 75-80
13. Shkolnikova M.A., Chuprova S.N., Kalinin L.A., et al. Magnesium metabolism and therapeutic significance of its preparations. A guide for doctors. Moscow: Medpraktika, 2002, 32 pages.
14. Reffelmann T., Ittermann T., Dorr M., et al. Low serum magnesium concentrations predict cardiovascular and all-cause mortality // Atherosclerosis, 2011, Vol. 219, pp. 280-284
15. Barbagallo M., Dominguez L.J. Magnesium and type 2 diabetes // World Journal of Diabetes, 2015, Vol. 6, No. 10, pp. 1152-1157
16. Guerrero R.F., Flores G.A., Saldaca G.S., et al. Obesity and hypomagnesemia // European Journal of Internal Medicine, 2016, Vol. 34, pp. 29-33
17. Hatzistavri L.S., Sarafidis P.A., Georgianos E., et al. Oral magnesium supplementation reduces ambulatory blood pressure in patients with mild hypertension // American Journal of Hypertension, 2009, Vol. 22, pp. 1070-1075
18. Stepura O.B., Martynow A.I. Magnesium orotate in severe congestive heart failure (MACH) // International Journal of Cardiology, 2009, Vol. 131, pp. 293-295
19. Stepura O.B., Martynow A.I. Magnesium orotate in severe congestive heart failure (MACH) // International Journal of Cardiology, 2009, Vol. 134, No. 1, pp. 145-147