SMJ Saratov Medical Journal
ISSN 2712-8253, Saratov Medical Journal
2024. Volume 5. Issue 2. Article CID e0201
DOI: 10.15275/sarmj.2024.0201

Original article

Reprint

Effect of remote monitoring system on lipid profile after myocardial infarction in urban and rural areas of Perm Krai

Grigory N. Spasenkov [1], Olga V. Khlynova [2], Natalya A. Koryagina [2], Vladimir S. Koryagin [2] ✉, Aleksandr S. Zagumennov [2], Egor A. Pesterev [2], Lyudmila A. Bankovskaya [2]
✉ vladimirkoryagin12@gmail.com

[1]Clinical Cardiology Dispensary, Perm, Russia
[2] Perm State Medical University, Perm, Russia

Received 3 May 2024, Accepted 25 May 2024

Abstract:
Objective: to assess the impact of the remote monitoring system on the lipid profile after myocardial infarction (MI) in urban and rural areas of the Perm Krai.
Materials and Methods. Our study conducted from 2020 through 2022 included 253 patients diagnosed with MI. The study compared two groups of patients: those who did not participate (n=105) and those who participated in the Remote Health Monitoring of Patients with Cardiovascular Diseases (RM) program (n=148). RM of patients was carried out at least once a month by telephone calls using an approved list of questions.
Results. The group of patients participating in the RM system exhibited a significant improvement in the lipid profile vs. groups of patients not participating in the RM program. The total cholesterol levels in the RM groups of Perm Krai and city of Perm were 3.77 and 4.30 mmol/L, respectively, vs. 5.50 and 4.50 mmol/L in the rural and urban groups without RM. Statistically significant differences between the groups were observed only in Perm Krai (p=0.002). The low-density lipoprotein (LDL) level in patients with RM was 1.77 mmol/L in Perm Krai and 2.31 mmol/L in the city of Perm vs. 3.24 and 2.67 mmol/L in the rural and urban groups without RM (p=0.049 and p=0.025), respectively). Patients in the RM group from Perm Krai were 15.6 times more likely to achieve target LDL values than their counterparts without RM.
Conclusion. The RM system had a favorable effect on reducing LDL and cholesterol in both urban and rural groups of residents.

Keywords: urban population, rural population, myocardial infarction, remote monitoring, lipid profile

Cite as: Spasenkov GN, Khlynova OV, Koriagina NA, Koryagin VS, Zagumyonnov AS, Pesterev EA, Bankovskaya LA. Influence of the remote monitoring system on the lipid profile after myocardial infarction in urban and rural areas of the Perm region. *Saratov Medical Journal* 2024; 5 (2): e0201. https://doi.org/10.15275/sarmj.2024.0201

Introduction

In response to the challenges of the COVID-19 pandemic, Perm Krai introduced innovative methods in healthcare in 2020. These included a remote monitoring (RM) system for patients with a high risk of cardiovascular diseases (CVD) known as Remote Health Monitoring of Patients with Cardiovascular Diseases. The implementation of this system was part of the regional program designed to combat diseases of the circulatory system approved on September 3, 2020 (Order #SED-34-01-05-355). RM presumes regular telephone consultations with patients, thereby providing timely monitoring of changes in their condition and minimizing direct contacts during the pandemic. Chief medical officers of medical institutions are in charge of managing the RM program [1].

Particular attention within the RM program is paid to monitoring the lipid profile of patients after myocardial infarction (MI). The lipid profile is an important indicator that has been proven to correlate with the risk of recurrent MI. Maintaining target blood levels of low-density lipoproteins (LDL) helps reduce the likelihood of subsequent cardiac complications. Regular monitoring and alteration of the lipid profile via remote interaction with patients allows doctors to more effectively manage this aspect of therapy after MI, which can significantly increase the patient's chance of successful recovery.

RM effectively complements outpatient monitoring, thereby providing an additional level of patient support outside a medical institution. However, it does not substitute standard follow-up care (according to the Order No. 173n of March 29, 2019) [2]. A 2015 Cochrane study including 12,947 patients and 41 randomized controlled trials confirmed that telephone-based support reduced all-cause mortality by 13% and number of hospital admissions for heart failure by 15% compared with standard monitoring [3].

Studies of the RM impact in different territories, including large cities and remote rural areas, are important for understanding how the effectiveness and availability of RM vary depending on the geographical location. Such studies would allow optimizing medical services in different regions, taking into account the specifics of each one.

Objective: To evaluate the impact of the remote monitoring system on the lipid profile after MI in urban and rural areas of the Perm Krai.

Materials and Methods

The study included 253 patients who were treated for MI in the public Clinical Cardiology Dispensary of Perm Krai from 2019 through 2022. All patients were offered to use the continuous dynamic monitoring system within the RM program. Some patients were not willing to do so, and they were included in Group 1 (n=105). On the contrary, patients in Group 2 were monitored through RM (system (n=148). The groups were characterized by statistically insignificant differences in terms of their gender and age composition. Then the patients were further divided into four groups depending on their affiliation with the capital of the region, the city of Perm, i.e., into urban and rural patients. This approach allowed assessing the effect of both RM and geographical affiliation on the lipid profile in patients after MI.

RM of the health in patients with high cardiovascular risk is a consistent dynamic monitoring of the patient aimed at timely detection of aggravation of the patient's condition and organization of medical care to correct treatment tactics. RM is a telephone session between an operator or medical staff member with a patient included in the RM program, conducted at a certain frequency, but not less than once a month. Based on the results of such telephone appointment, the need for further in-person consultation of the patient with medical staff, additional examination and identification of treatment tactics is determined. Responsibility for organizing the RM of the health in patients suffering from CVD is assigned to the chief medical officers of institutions providing primary health care and primary specialized care in the Perm Krai.

The RM system is primarily an addition to the follow-up care: it cannot be considered as a replacement for face-to-face contact between a doctor and a patient. The main task of RM is to increase the frequency of communication with the healthcare system for patients suffering from CVD in between follow-up care appointments.

All patients included in the study gave voluntary informed consent in accordance with the requirements of the Order No. 163 (OST 91500.14.0001-2002) of the Russian Federation Ministry of Healthcare and 1993 international ethical requirements on the part of the World Health Organization and the Declaration of Helsinki of the World Medical Association on conducting biometric research on human subjects. Permission was obtained from the Ethics Committee at Perm State Medical University.

The collected data were subjected to statistical analyses using parametric and nonparametric methods. In the study, quantitative data with a normal distribution were analyzed using the mean (M) and standard deviation (SD), as well as the 95% confidence interval (CI). For data that did not comply with a normal distribution, the median (Me) and quartiles (Q1-Q3) were used. To compare means in normally distributed data, we employed the Student's t-test. For non-normal distributions, the Mann-Whitney U test was performed. Nominal data were described through absolute values and percentages, and their comparison was conducted via the Pearson's chi-squared test.

Data processing, including their adjustment, systematization, and visualization, was performed in Microsoft Office Excel 2016. For statistical analyses, the IBM SPSS Statistics v.26 software developed by IBM Corporation was used.

Results

Gender and age characteristics, residential area (urban or rural) of patients diagnosed with MI depending on their affiliation with the capital of the region, the city of Perm, and the use of RM are presented in *Table 1*.

When analyzing the gender and age characteristics of the study groups identified in the subanalyses, we did not detect statistically significant differences.

The assessment of the proportions of those who voluntarily agreed to the RM program in the city of Perm and Perm Krai yielded statistically significant differences (*Table 2*). The probability of voluntary participation in the RM system among rural population (Perm Krai) was 3.5 times higher vs. urban group of patients (Perm), and the differences in odds were statistically significant ($p<0.001$) (95% CI: 1.913-6.541).

Based on the analysis of the lipid profile in patients depending on their involvement in the RM program and their affiliation with the city of Perm (*Table 3*), we determined that the level of total cholesterol (TC) significantly improved in the groups with RM in both residential options (3.77 mmol/L in Perm Krai and 4.30 mmol/L in Perm) vs. the groups without the use of RM (5.50 and 4.50 mmol/L, respectively). The differences between the groups with and without the use of UM were statistically significant only in the groups of Perm Krai ($p=0.002$).

LDL also showed improvement among patients with RM (1.77 mmol/L in Perm Krai and 2.31 mmol/L in Perm) vs. those who did not participate in RM (3.24 and 2.67 mmol/L, respectively), with p-values of 0.049 and 0.025, respectively.

It is worth noting that the RM groups exhibited a tendency to achieve target LDL values, even though they did not achieve them.

Patients in the RM groups, regardless of their place of residence, more often achieved target LDL values. For instance, rural patients who adhered to RM were 15.6 times more likely to achieve target LDL values compared with the group not involved in RM (95% CI: 3.56-58.11).

For high-density lipoproteins (HDL), statistically significant differences were observed in the RM group in Perm Krai (1.20 mmol/L vs. 0.92 mmol/L without RM) ($p=0.016$), but not in the city of Perm (1.10 mmol/L with RM vs. 1.02 mmol/L without RM) ($p=0.157$).

Triglycerides and index of atherogenicity did not demonstrate statistically significant differences between the RM and non-RM groups both in rural and urban patients, thereby indicating heterogeneity of the RM effect on these parameters.

Comparisons between urban and rural patients exhibited statistically significant differences in cholesterol ($p=0.045$) and HDL ($p=0.049$) levels, implying potential differences in the RM effect in urban and rural areas. These data highlight the importance of RM in improving lipid profiles and preventing recurrent MI and the need for further study of its effects in different geographical settings.

Table 1. Gender and age characteristics of study groups

Parameter	Patients				Comparisons	
	Rural (from Perm Krai)		Urban (from city of Perm)		Within the entire region	Urban/rural
	Without RM, *n*=19	RM, *n*=74	Without RM, *n*=64	RM, *n*=72	p_{1-2} p_{3-4}	p_{1-3} p_{2-4}
	1	2	3	4		
Male, absolute value (%)	13 (68.4)	57 (75.0)	55 (64.0)	46 (63.9)	0.560	0.712
Female, absolute value (%)	6 (31.6)	19 (25.0)	31 (36.0)	26 (36.1)	0.993	0.154
Age, *M±SD*, years	63.5±9.9	62.6±10.9	67.8±13.4	65.4±12.8	0.746 0.266	0.194 0.154

RM, Remote Health Monitoring of Patients with Cardiovascular Diseases program.

Table 2. Rural and urban patients who voluntarily agreed to use the remote monitoring system

Parameter	Patients, absolute value (%)		*p*
	From Perm Krai, *n*=93	From city of Perm, *n*=136	
Availability of voluntary consent to participate in the RM program	74 (80.9)	72 (54.4)	<0.001

RM, Remote Health Monitoring of Patients with Cardiovascular Diseases program.

Table 3. Assessment of the lipid profile in patients

Parameter	Patients				Comparisons	
	From Perm Krai		From city of Perm			
	Without RM, *n*=19	RM, *n*=74	Without RM, *n*=64	RM, *n*=72	Within the entire region	Urban/rural
	1	2	3	4	p_{1-2} p_{3-4}	p_{1-3} p_{2-4}
TC, mmol/L, *Me* (Q_1-Q_3)	5.50 (4.15-6.39)	3.77 (3.1-4.62)	4.50 (3.48-5.28)	4.30 (3.46-5.0)	0.002 0.640	0.779 0.045
LDL, mmol/L, *Me* (Q_1-Q_3)	3.24 (3.11-3.67)	1.77 (1.5-2.5)	2.67 (1.88-3.62)	2.31 (1.8-2.96)	0.025 0.049	0.275 0.010
Achieving target values of LDL, mmol/L, absolute value (%)	0 (0.0)	18 (24.3)	10 (15.6)	12 (16.6)	0.001 0.456	0.001 0.052
HDL, mmol/L, *Me* (Q_1-Q_3)	0.92 (0.7-0.95)	1.20 (1.08-1.44)	1.02 (0.9-1.42)	1.10 (1.0-1.34)	0.016 0.157	0.100 0.049
TG, mmol/L, *M±SD*	1.80±0.64	1.38±0.55	1.49±0.70	1.53±0.70	0.081 0.801	0.332 0.199
Index of atherogenicity, *Me* (Q_1-Q_3)	3.1 (3.10-4.00)	2.13 (1.56-2.69)	2.7 (1.80-3.96)	2.2 (1.89-2.99)	0.007 0.451	0.710 0.112

RM, Remote Health Monitoring of Patients with Cardiovascular Diseases program; TC, total cholesterol; LDL, low-density lipoproteins; HDL, high-density lipoproteins; TG, triglycerides.

Discussion

Currently, the continuous dynamic monitoring system of the Perm Krai regional project known as Remote Health Monitoring of Patients with Cardiovascular Diseases has a favorable effect on the general condition of patients with MI. The results of our study are indicative of an improvement in the lipid profile of patients participating in the RM program vs. those who were not willing to participate in the program. Besides that, our results suggest that RM may have a stronger impact on the rural (as opposed to urban) population by compensating for poorer availability of medical services. This

finding opens up new prospects for further study and use of RM as an effective means of improving cardiovascular health in various socioeconomic conditions, especially in areas with limited access to conventional health care services.

In the context of the COVID-19 pandemic, the active use of telemedicine technology has become a key feature in many regions, including the Perm Krai. Similar experience was reported in the USA, where a program for monitoring the condition of patients with a previous MI was implemented. The monitoring was carried out via mobile application aimed at tracking the symptoms of conditions associated with the disease. According to the study, patients who actively and voluntarily used this application were less likely to seek emergency medical care and more likely to achieve target LDL and TC levels [5].

Based on the data collected in our study, we propose that the RM system has an advantageous effect on the diseases of the circulatory system.

It should be noted that the entire cohort of patients at the stage of discharge from the Regional Vascular Center was offered both voluntary participation in the RM program and the clinical trial. A feature of the patient distribution among groups was the fact that after discharge from the clinic, all patients were given recommendations to register with a relevant medical specialist at their place of residence and enroll in the RM system. However, in actual practice, not all patients followed these recommendations.

Conclusion

One of the main causes of mortality and disability in the population is MI. The introduction of the RM system in 2020 in the Perm Krai made it possible to achieve significant results in providing health care to patients with MI. Summarizing the experience of this study, we point out the significant role of RM in optimizing the lipid profile in patients after MI. Our data demonstrate that the use of RM is associated with a statistically significant improvement in TC and LDL levels in patient groups in both urban and rural settings. This finding emphasizes the importance of introducing RM technology into clinical practice as an effective means of improving the quality of treatment and prevention of CVD.

It is important to note that, despite the positive traits of RM, traditional face-to-face interaction between a doctor and a patient remains an integral part of medical practice. RM should be considered as a complement to conventional follow-up care rather than a substitute for it.

The results of our study unequivocally confirmed that RM is a valuable tool for improving medical care for patients with CVD: it can significantly contribute to reducing the possible recurrence of MI. The RM system triggers a favorable effect on reducing LDL and TC levels in groups that voluntarily agreed to RM, regardless of the patient's place of residence (urban or rural).

Author contributions: All authors contributed equally to the preparation of the manuscript.

Conflict of interest: None declared.

References

1. Sukhanov MS, Karakulova YV, Prokhorov KV, et al. Experience of using remote monitoring of patients suffering from cardiovascular diseases in Perm Krai. *Cardiovascular Therapy and Prevention* 2021; 20 (3): 87-90. (In Russ.).
2. On approval of the procedure for conducting follow-up care of adults. Order of the Ministry of Healthcare of the Russian Federation, 29 March 2019, No. 173n. URL: https://normativ.kontur.ru/docRMent?moduleId=1&docRMentId=334441 (26 Oct 2023). (In Russ.).
3. Inglis SC, Clark RA, McAlister FA, et al. Structured telephone support or telemonitoring programmes for patients with chronic heart failure. *Cochrane Database Syst Rev.* 2010; (8): CD007228. https://www.doi.org/10.1002/14651858.CD007228
4. Acute myocardial infarction with ST segment elevation on the electrocardiogram: Clinical recommendations. 2020. URL: http://disuria.ru/_ld/10/1012_kr20I21I22mz.pdf (26 Jun 2023). (In Russ.).
5. Biancuzzi H, Dal Mas F, Bidoli C, et al. Economic and performance evaluation of e-health before and after the pandemic era: A literature review and future perspectives. *Int J Environ Res Public Health* 2023; 20 (5): 4038. https://www.doi.org/10.3390/ijerph20054038

Authors:
Grigory N. Spasenkov – applicant for a degree in the Department of Hospital Therapy; Cardiologist, https://orcid.org/0000-0003-1085-5814;
Olga V. Khlynova – DSc, Corresponding Member of the Russian Academy of Sciences, Chair of the Department of Hospital Therapy, https://orcid.org/0000-0003-4860-0112;
Natalya A. Koryagina – DSc, Professor, Department of Outpatient Therapy, https://orcid.org/0000-0001-5980-2364;
Vladimir S. Koryagin – Student, https://orcid.org/0009-0000-4834-2905;
Aleksandr S. Zagumennov – Student, https://orcid.org/0009-0002-1302-7379;
Egor A. Pesterev – Student, https://orcid.org/0009-0001-9605-9474;
Lyudmila A. Bankovskaya – DSc, Professor, Chair of the Department of Public Health and Healthcare #2 with a Course in Healthcare, https://orcid.org/0000-0003-4267-8031.