DISORDER PATTERNS OF THE MYOCARDIUM PERFUSION OF THE CIVIL AVIATION PILOTS

G.H. Khachatryan,
K.V. Khondkaryan,
A.G. Karapetyan

Scientific Center of Radiation Medicine and Burns, Ministry of Health, Republic of Armenia, Yerevan

Gayane H. Khachatryan, *MD, PhD, Head of Radionuclide Laboratory; Head of the Department of Radiation Diagnosis at Faculty of Postgraduate Education of Erivan State Medical University*

Karine V. Khondkaryan, *MD, Radiologist; Assistant Professor at Faculty of Postgraduate Education of Erivan State Medical University*

Anahit G. Karapetyan, *PhD in Biology, Scientific Secretary*

INTRODUCTION

The arsenal of the radiation research methods is the most informative part of the diagnostic methods of the clinical medicine; they make it possible to "in vivo" examine both anatomical and functional characteristics of different organs and systems. However, each of the methods (R-CT, MRI-tomography, ultrasound and radionuclide research methods) has its positive and negative sides and limits of information value.

The last circumstance is particularly vital for the study of such multi-functional organs and systems like the heart. In this connection the clinician doctor faces a serious challenge — the choice of the clinically expedient and methodologically most informative research method for the specific clinical aim, especially of the people with specific working conditions like pilots with 20 and more years of working experience.

RELEVANCE

Taking into account the work specificity (the occurrence of positive and negative overloads, vibration and noise) the methods of heart topography, enabling to approach the pathophysiological mechanisms of the disorders of the myocardium perfusion most closely have been chosen by us in the framework of the current research. [1, 2, 3].

The condition of the myocardium perfusion of the patients who have not suffered from myocardial infarction, but have an expressed pain of various intensity levels, is a complex clinical task of current importance. It gets even more complicated due to a great many ambiguous factors influencing the development of the pathological process, that are present in the air crew with at least 20 years of experience.

We have not found any research and works on this topic in the available literature with the use of scintigraphy.

AIM AND OBJECTIVES

Based on the above mentioned, the aim of the present study was to examine the myocardium perfusion of the air crew with the exposure of the peculiarities of this disorder. To reach these aims the following objectives have been set:

1. The definition of the disorder of the myocardium perfusion.
2. The exposure of the disorder section and the area of the myocardium damage.
3. The reaction of the myocardium on the pharmacological assay and the exposure of the change peculiarities on the stress factor.
4. The exposure of general and specific patterns of myocardium perfusion disorders of the left ven-

tricle in case of rest and pharmacological load and their comparative characteristics.

5. The peculiarities of perfusion disorders of the air crew.

MATERIALS AND METHODS

16 individuals (pilots with a working experience of over 20 years) without any clinical and laboratory indications of a past myocardial infarction have been examined. The reasons for referral were unstable angina pectoris, arrhythmia and oscillation of the arterial pressure.

All the patients underwent echocardiography with a Treadmill test and all the clinical biochemical tests.

Research methodology is perfusion scintigraphy with radioactive technetium and an MIBI (Technetril) kit. The research was carried out on the"SPECT" camera ("Mediso" – Hungary). The step of the tomographic scanner is 5,6o, the angle of the detector rotation around the heart is from 60° to 240° . The number of shots is 32. The section is 5mm along all three tomographic axes. The research was carried out in 2 stages: the first one an hour after intravenous Tc-99m-MIBI, with 22–24 mGi activity, the second one right after the first tomography after taking two nitroglycerine pills. The final assessment of the obtained information was given in the form of qualitative and quantitative assessment of the level of the myocardium perfusion disorder along the three axes, all the sections on the basis of the "heart map" and the overall percentage of the myocardium damage of the left ventricle [1, 2, 4].

Afterwards a comparative characteristics of tomo-scintigram was performed before and after the loading test.

To optimize the interpretation of the tomographic data the following standards have been chosen- the program pack of IAEA and the IAEA guidelines for the assessment of the perfusion disorder.

The normal seizure is assessed in case of diffuse-uniform redistribution of the indicator from 100% to 70% from the administered activity, an insignificant reduction of the bloodstream being 70–50%, mean being 50–30%, significant being 30–10% and profusion absence being 0–10%.

Another benchmark for the assessment of the disorder level of the left ventricle myocardium is the number of damaged segments by the nine-segment model.

In case of 1–2 segment damage — the perfusion damage is insignificant, in case of 3–4 — it is moderate, in case of over 5 segments- perfusion damage is significant.

RESULTS AND DISCUSSIONS

The following results have been obtained:

1. Profusion disorders of different levels have been discovered in all the individuals under examination.
2. More vulnerable sections were localized along apical septal and anterolateral walls of the left ventricle. Bigger areas of damage are on the back wall from the septum to the lateral sections. Accordingly, the reduction level was 50% and the number of segments was 3–4.
3. Signs of concentric hypertrophy of the left ventricle myocardium were discovered in 90% of patients and signs of eccentric hypertrophy were discovered in 10% : reduction level of the latter reached 70% and the number of segments was 4–5.
4. During the comparative assessment of the two stages of research(rest and stress) mainly signs of activity redistribution (91%), signs of hidden faults (57%), signs of stealing(36%), improvement of the general profusion of two patients and improvement of local areas of 36–38% have been revealed.

The last fact (improvement of local areas) is the most important clinical pathophysiological sign of the possible recovery of the myocardium perfusion.

The analysis of the tomoscintigraphy results makes it possible to assume that the condition of the myocardium perfusion of the left ventricle of the air crew can be a model of hibernated myocardium, described by Rahimtoola S.H.(1980) and и Narahara R.A.(1990).

The main task of the present report is the definition of the zones of reversible ischemia and areas of nonviable myocardium. The perfusion disorders, as described by Narahara R.A. (1990) can be revealed in the areas of viable , but "hibernated" or deafened myocardium as well.

Naturally the best method of identifying the hibernated zones is PET-tomography.

Perfusion single-photon tomography at rest and myocardium scintigraphy in combination with nitroglycerine assay made it possible to show the increased indicator accumulation with the method of the qualitative analysis. Myocardium viability (in different segments of the left ventricle myocardium) was revealed in almost one third of the patients.

The authors (Rahimtoola S.H. и Narahara R.A.) [6, 7] have singled out a fundamental moment of the hibernation essence, that "oppression of the retractive function of the myocardium proceeds parallelly" with the ischemia level. At the same time decrease of

the inotropic function of the hibernated myocardium is presented as the regulatory defensive reaction in response to the energy deficit in cardiomyocytes.

All the clinical conditions which can lead to myocardium hibernation are seen in the examined group, conditioned by the permanent harmful professional work factors.

From the practical point of view the presence of hibernated myocardium is a weighty prognostic factor for the recovery of the damaged perfusion.

Pathophysiological mechanisms of the obtained results

In case of the coronary blood flow to the critical level or in case of relative supply insufficiency of the myocardium with oxygen there emerges oxygen starvation on "the respiratory chain" level. As a result of termination of the aerobic catabolism glycogenolysis and anaerobic glycolysis are reinforced, in which case energy production volume is in direct relation to the blood supply of the myocardium. The latter circumstance emphasizes the significance of the myocardium perfusion study to determine the level of ischemia of the cardiac muscle.

The principal sign of ischemia is that the need for macroergic phosphates increases their formation speed and as a result the level of these compounds in the cell decreases quickly. After a few seconds of total ischemia creatine phosphate supply in cardiomyocyte is totally exhausted [5].

The effective perfusion contributes to the recovery of the retractive function of the reversibly damaged cardiomyocytes only after the normalization of energy production and decrease of the intracellular calcium concentration. Sometimes the recovery of the retractive function of the heart after the restoration of coronary blood flow takes place with some delay ("Deafness of the myocardium"). [3, 8].

In case of the absence of adequate reoxygenation of the heart the ischemic changes of the intracellular metabolism lead to structural morphological changes of cardiomyocytes right up to their death with the formation of postinfarction cicatrices. The consequence of such a disorder (damage) is the irreversible disorder of the retractive function of the myocardium [3].

Thus, myocardium tomoscintigraphy is one of the necessary examinations as an indicator of the myocardium perfusion condition and predictor of the possible complications.

REFERENCES

1. **A.A. Kramer** – Radionuclide methods of myocardium examination, M., 1982, – 78 p.
2. **V.I. Chernov, S.M.Salpagarov and others.** – Methodical aspects of the use of single-photon emission computer tomography with Tc-99m-technetril for the prognosis of the course of coronary heart disease, / Medical Radiology and Radiation Safety/, 2002, №1, pp.39–40.
3. **Yu.B.Lishmanov, V.I. Chernov, V.E.Babokin and others.** Scintigraphic, ultrasound evaluation of the viability of a hibernated myocardium under a dopamine sample, / Medical Radiology and Radiation Safety, 2002, №1, pp. 46–53.
4. **A.I. Kuzin, L.A. Gabbasova, A.V. Vazhenin** Clinical and radiological analysis of myocardial scintigraphy with Tc-99m-technetril,/ Roentgenology and Radiology Newsletter, 1999, №1, pp. 9–11.
5. **Narahara R.A., Villanueva-Mayer J., Thompson C.J.**/ American Journal of Cardiology, 1990, 66(20), p. 1438–1444.
6. **Rahimtoola S.H.** Importance of diagnosing hibernating myocardium: how and in whom./American Journal of Cardiology, 1997, 30, p. 1701–1706.
7. **Rahimtoola S.H.** The hubernating myocardium. American Journal Hearth, 1989, 117, p. 211–221.
8. **Makarova E.V., Chernov V.I. et al.,** Radionuclide diagnostics of infringements of metabolic processes of a myocardium at ischemic illness of heart. / Medical radiology and radiation safety, 2005, №3, pp. 53–60.