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THE CHOICE OF THE OPTIMAL EXPERIMENTAL MODEL OF MYOCARDIAL INFARCTION

V. V. Koval'skaja, I. V. Savytskyi, A. A. Mironov

Odessa National Medical University, Odessa

Abstract

Nowadays myocardial infarction has a high percentage of mortality [12], and is widespread in Ukraine and Western countries [1, 2, 3]. Such a situation calls for the development of a new model of myocardial infarction, which would be as simple and effective as possible. In this article, a model of myocardial infarction with the use of inhalation anesthesia with chloroform is proposed.

Key words: myocardial infarction, experiment, experimental model, rat, chloroform, adrenaline.

ВИБІР ОПТИМАЛЬНОЇ ЕКСПЕРИМЕНТАЛЬНОЇ МОДЕЛІ ІНФАРКТУ МІОКАРДУ

В. В. Ковальська, І. В. Савицький, А. А. Миронов

Одеський національний медичний університет, Одеса

Резюме

На сьогодняшній день інфаркт міокарда має високий відсоток летальності [12], та широку розповсюдженість на території України та країнах Заходу [1, 2, 3]. Така ситуація зумовлює необхідність розробки нової моделі інфаркту міокарда, яка була б

максимально простою та ефективною. В даній статті запропонована модель інфаркту міокарду, з застосуванням інгаляційного наркозу хлороформом.

Ключові слова: інфаркт міокарда, експеримент, експериментальна модель, щур, хлороформ, адреналін.

Relevance of the topic: On the materials of the Ministry of Health in Ukraine the problem of acute myocardial infarction among diseases of the cardiovascular system is in the first place today. Myocardial infarction affects mainly the able-bodied population and at the same time, the percentage of mortality is high. The mortality statistic from this disease remains stably high - from acute myocardial infarction in Ukraine, 30% of patients die, while in Western countries it is 5% [1, 2, 3].

This puts the task of experimenters to form a simple, convenient and effective model of myocardial infarction.

Scientists have already conducted experimental studies to create models of myocardial infarction, but this was a practical application, during which experimenters corrected coronary blood flow to achieve ischemia and necrosis.

So in 2013, an experimental model was proposed that was based on ligation of the posterior interventricular branch of the right coronary artery, which led to ischemia and led to myocardial infarction [4].

A method for modeling ischemic myocardial damage in rats based on parenteral administration of histotoxic doses of adrenomimetics with a simultaneous physical effect on the animal organism is known. The essence of the model was that after 2-3 minutes after subcutaneous injection of 0.1 ml 0.1% solution of adrenaline hydrochloride in the rat, the animal was "raised" to the altitude chamber height of 11,000 m and conducted continuous monitoring of the electrocardiogram under high-altitude hypoxia conditions. Appearance of a horizontal reduction of the ST segment by 1 mm and lower from the initial value during 2-3 minutes indicates the ischemic damage of the myocardium [5].

Earlier, extirpation of the heart was performed using retrograde perfusion according to Langendorf. New models have a number of advantages in comparison with earlier ones. Thus, with the development of experimental modeling methods, the need for complex interventions is gradually eliminated and the techniques are accelerated and simplified.

The purpose of the study: the creation of an adequate model of myocardial infarction, which would be as simple and effective in execution as possible. This model will allow to simulate myocardial infarction in rats without surgical and specific interventions.

Materials and methods: The study was carried out on 19 male rats of the Wistar line, with an average mass of 134 ± 5.2 g, aged 3 to 9 months.

The animals were divided into 3 groups. The first group (n = 15) included rats who received inhalation anesthesia consisting of pure chloroform vapors. In the 2nd group (n = 2) there were rats who received inhalation anesthesia consisting of pure chloroform vapors and a solution of epinephrine hydrochloride intravenously. In the third group (n = 2) were control animals.

During the experiment, the animals were placed in a container and then a cotton swab was placed there with 5 ml of a solution of pure chloroform. Being in the container for 5 to 7 minutes, sedation was observed in the animals and then a complete loss of reaction to the environment was. After 5-7 minutes, the animals were removed from the container. After recovery from the controlled environment, respiratory arrest, convulsions, rapid heartbeat, and then its absence and complete loss of sensitivity were observed. 10 minutes after the injection of anesthesia in rats, respiration and palpitation were not restored, and there was a complete absence of reflexes, which indicated the death of the animal. During the experiment, the cardiac muscle was withdrawn from animals and sent for histological examination.

In the second group, after removal from the container, an adrenaline hydrochloride solution of 0.15 mg (0.1%, 1 ml) was injected into the tail vein. A minute after the adrenaline injection, in the animal was resumed pain sensitivity, there was rapid breathing and palpitations.

Five minutes after the injection, the rats were active. After a day of being in normal conditions, the animals underwent decapitation and then the removal of the heart muscle.

Results: These studies were conducted to compare the animals of the control group with those who received inhalation anesthesia, as well as those who received an adrenaline hydrochloride solution 0.15 mg (0.1% 1 ml).

Analyzes showed that in animals that received only inhalation anesthesia with 100% chloroform was a period of acute decompensation which manifested itself in a decrease in hemoglobin, mean hemoglobin in erythrocyte, granulocytes.

In rats who received as resuscitation an adrenaline hydrochloride solution of 0.15 mg (0.1% 1 ml) intravenously the data were close to normal, indicating a period of compensation.

General blood analysis.

Animals that received inhalation anesthesia with 100% chloroform:

	Rat 1	Rat 2
Leukocytes	5,4 x10^9/L	15,9 x10^9/L
Lymphocytes	3,6 x10^9/L	10,3 x10^9/L
Monocytes	0,2 x10^9/L	0,8 x10^9/L
Granulocytes	1,6 x10^9/L	4,8 x10^9/L
Erythrocytes	5,17 x 10^12/L	7,4 x 10^12/L
Hemoglobin	81g/l	126 g/l
Hematocrit	30,8 %	37,7 %
Average volume of erythrocyte	59,7 fL	51,0 fL
The average hemoglobin in erythrocyte	15.6 pg	17,0 pg
The average concentration of hemoglobin in erythrocyte	262 g/l	334 g/l
Width of distribution of erythrocyte by volume	20.6%	16,7 %

Rats that received inhalation anesthesia with chloroform with followed administration of adrenaline hydrochloride 0.15 mg (0.1% 1 ml) intravenously.

	Rat 1	Rat 2
Leukocytes	7,1 x10^9/L	6,1 x10^9/L
Lymphocytes	8,8 x10^9/L	7,8 x10^9/L
Monocytes	0,5 x10^9/L	0,1 x10^9/L
Granulocytes	4,1 x10^9/L	2,2 x10^9/L
Erythrocytes	7,72 x10^12/L	4,61x10^12/L
Hemoglobin	136 g/l	134 g/l
Hematocrit	43,5%	42,2%
Average volume of erythrocyte	56,4 fL	50,4 fL
The average hemoglobin in erythrocyte	17,6 pg	14,7 pg
The average concentration of hemoglobin in erythrocyte	312 g/l	293 g/l
Width of distribution of erythrocyte by volume	18,5 %	16,3 %

Control group of animals.

	Rat 1	Rat 2
Leukocytes	7,2 x10^9/L	7,0x10^9/L
Lymphocytes	11,7 x10^9/L	11,8 x10^9/L
Monocytes	0,7 x10^9/L	0,5 x10^9/L
Granulocytes	4,1 x10^9/L	4,7 x10^9/L
Erythrocytes	7,14 x10^12/L	9,71 x10^12/L
Hemoglobin	134 g/l	132 g/l
Hematocrit	34,8 %	53,7 %
Average volume of erythrocyte	48,8 fL	55,4 fL
The average hemoglobin in erythrocyte	21,2 pg	21,5 pg
The average concentration of hemoglobin in erythrocyte	313 g/l	245 g/l
Width of distribution of erythrocyte by volume	18,0 %	18,8 %

Conclusion:

The study shows the possibility of using chloroform as a method of provoking myocardial infarction in rats. Based on the obtained data, a fast, relatively simple and effective experimental model of myocardial infarction can be generated.

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