

## Standard Structural Response of Myocardium to Damage by Various Factors: A Morphometric Study

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### Abstract

**Introduction:** By the classical descriptive method it is established that the myocardium responds to any negative effects with a standard and very limited set of structural changes.

**Purpose:** Verification of this statement with the help of a modern morphometric method of the research that meets the principles of an evidence-based medicine.

**Material and Methods:** The myocardium of 50 dead patients with schizophrenia (men - 31, women - 19; age from 26 to 6 years) was studied: I group (20) - the control, II one (13) - sudden cardiac death, III one (17) - neuroleptic malignant syndrome. The paper uses the author's own algorithm for the study of myocardial microstructure. The received results were statistically processed by the nonparametric Mann-Whitney U-test with significance level of 5%.

**Results:** The developing in the case of sudden cardiac death changes has an acute character and reflects the statistically significant shifts of the respective quantitative parameters showing fast processes in the myocardium. The similar changes of the myocardium were observed in neuroleptic malignant syndrome. There were no fundamental qualitative and statistically significant quantitative differences between these two groups of observations.

**Conclusion:** The results of the study objectively confirm that CMCs react to any destructive impacts by very limited set of the nonspecific standard stereotypic structural modifying.

**Keywords:** Changes of Myocardium; Sudden Cardiac Death; Neuroleptic Malignant Syndrome; Comparative Morphometric Study

### Abbreviations

CMC's: Cardiomyocytes; KI: Kernogan Index; NMS: Neuroleptic Malignant Syndrome; RIE: Rate of Interstitial Edema; SCD: Sudden Cardiac Death; SPR: Stromal-Parenchymatous Ratio; SVAC: Specific Volumes of Atrophied CMC's; SVDC: Specific Volume of Dystrophic CMC's; SVHC: Specific Volumes of Hypertrophied CMC's; ZPD: Zone of Pericapillary Diffusion

### Introduction

It is known that the myocardium reacts to influence of various damaging factors by rather limited set of stereotypical nonspecific tissue and cellular reactions [1-3].

These changes relate to the structural components of the myocardium, as the microvasculature, intracellular matrix and the CMC's [4-7].

However, these data were come into at a research of a myocardium fortune in various pathological states with use of a classical descriptive method.

At the same time, at the current stage of development of science, a purely descriptive approach to the study of pathological processes is insufficient for accurate and, most importantly, an objective feature of the observed pathological changes.

Therefore, application of the morphometric methods of a research answering to the principles of modern evidential medicine [8,9] and giving to the received results and the drawn conclusions objectivity and relevant scientific value [10,11] is insistently necessary.

Proceeding from the above, studying of reaction of a myocardium to various stressful situations - for example, approach of SCD and development of NMS - by means of a morphometric method of a research for the purpose of specification of level of stereotypification of structural changes is of a certain interest.

### Material and Methods

The myocardium of 50 dead patients with schizophrenia (men - 31, women - 19; age from 26 to 66 years) was studied by a morphometric method of research.

During their lives the patients received various antipsychotic (neuroleptic) drugs in quantities corresponding to the therapeutic standard; these medicines are not rarely received in combination with each other. The duration of antipsychotic therapy ranged from six months to 20 years or more.

The criteria of an exception were coronary heart disease, heart defects, a hypertension in a small circle of blood circulation, expressed metabolic disorders, such as a metabolic syndrome and its components (the increased body weight, arterial hypertension, and a diabetes mellitus), and a cachexia.

The material of study is divided into the three groups: I (control) - 20 patients without any heart pathology who died of acute non-cardiac causes; II - 13 patients in whom SCD was found; III - 17 lethal cases of NMS without concomitant heart diseases.

Myocardium slices from various departments of the left ventricle were filled in paraffin, cuts were painted by hematoxylin and eosin. Respective objects were studied in 10 different fields of microscope, with necessary magnifications with the help of an ocular micrometer, the point count method was also used [10,11].

The paper uses the author’s own algorithm for the study of myocardial microstructure [5]. So, such parameters as ZPD, KI, SPR, and RIE were calculated. Cytometry of CMC’s were performed, SVHC, SVAC, and - by the method of polarization microscopy - SVDC were determined. The above-named parameters describe a condition of three structural components of myocardium: of microvasculature (ZPD and KI), intercellular matrix (SPR and RIE), and parenchyma (SVHC, SVAC, and SVDC).

The received results were statistically processed by the nonparametric Mann-Whitney U-test with significance level of 5%.

### Results and Discussion

The results of the study are shown in table 1. The analysis of these data allows establishing the following.

Groups	Microvasculature		Intercellular Matrix		Cardiomyocytes		
	ZPD	KI	SPR	RIE	SVHC	SVAC	SVDC
I APT	128.5	1.42	10.3	9.8	16.9	8.4	5.7
II SCD	176.1*	1.27*	9.1	34.8*	15.1	8.6	28.1*
III NMS	177.5*	1.48	7.8	33.4*	8.9	7.6	17.8*

**Table 1:** Morphometric indicators of a myocardium.

Note: \*: Statistically significant differences with group I.

As can be seen from the comparison of indicators in groups I and II, the myocardium morphology of the patients, who received antipsychotics, is strongly affected by SCD [4,12,13]. The developing in the case of SCD changes has an acute character, so as parameters reflecting myocardial changes that require a relatively long time for their development (SPR, SVHC, SVAC) remain stable. These changes reflect the statistically significant shifts of the respective quantitative parameters showing fast processes in the myocardium (KI, RIE, ZPD, SVDC).

After SCD the considerable acute disturbances of microcirculation in the form of paresis of myocardium microvessels are observed. The decrease of value of KI documents this process. The microcirculation disorders cause a tissue hypoxia, increase of the permeability of capillary walls and the development of an interstitial edema (a clear increase in RIE).

The edema separates the nutritive capillaries and CMC's, what shows a growth of ZPD [14]. This deeply violates the trophism of CMC's and leads to their dystrophic-degenerative changes (an increase of SVDC) [14,15].

The described changes of CMC's are the material basis of electrical instability of myocardium. This condition is extremely dangerous due to the high risk of severe arrhythmia and sudden cardiac death [4,12,13,16].

Thus, when SCD occurs itself in received antipsychotics mentally ill patients pathomorphological changes in myocardium have a rather limited set of disturbances of all its structural components. These violations are acute. The reactivity of myocardium is on a quite high level at the same time.

Vegetative changes observed in the development of NMS, place high demands on the heart [6,17]. Therefore, it is no coincidence that most often such patients die from heart disease [6,7,17].

As shown by the own research, myocardial reactivity in NMS is at a high level, and myocardium morphology is strongly affected by NMS [6,7,15]. In NMS the violations of myocardium affect all its structural components (microvasculature, intercellular matrix, and CMC's) and arise acutely. So, the development of NMS is accompanied by statistically significant deviations of such parameters as ZPD, RIE, SVDC (a comparison of groups I-III). Such changes are related to serious disturbances of microcirculation, an edema of intercellular matrix and apparent degenerative modifying of CMC's.

Comparison of myocardial changes observed at the onset of SCD and the development of NMS (group II - III) revealed no fundamental qualitative and statistically significant quantitative differences.

This allows us to consider and directly proves that the pathomorphological changes in the myocardium in both cases, are stereotypical and present a rather limited set of disturbances of all its structural components, such as microvasculature, intercellular matrix, and CMC's.

### Conclusion

The morphometric researches of the pathological shifts of a myocardium developing at SCD and NMS revealed essential distinctions in a comparison with control.

The structural injury of a myocardium in these two sharply developing pathological states look like the intense violations of microcirculation, an edema of intercellular matrix, and dystrophic-degenerative changes in CMS's.

On the other hand, there were no essential differences in structural changes of a myocardium in both pathologies.

These results objectively confirm that CMC's react to any destructive impacts by very limited set of the nonspecific standard stereotypic structural modifying.

### Conflict of Interest

The author declare that they have no conflict of interest.

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