Histomorphometric assessment of changes in the acinus and islets of Langerhans’ of the pancreas under conditions of general dehydration of the body

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Dehydration accompanies a number of pathological conditions and causes alteration of the organs and systems of an organism. Research aim: to study histomorphometric changes in pancreas under the conditions of general dehydration of an organism, to identify correlation between the studied groups. The experiment was carried out on 35 white male rats. Pancreas was stained with haematoxylin and eosin and also Van Gieson’s stain was used. The size of acini and islets of Langerhans and other parenchyma formations were assessed. The acini area of has decreased by 6.5% ($p>0.05$) in comparison with the intact group on the 3rd day. The area of islets of Langerhans decreased by 2% ($p>0.05$) in comparison with the intact group. The area of islets of Langerhans has increased by 0.2% ($p>0.05$) in comparison with the control group and by 2.2% ($p>0.05$) in comparison with the 3rd day. Acini area has increased by 7.2% ($p>0.05$) on the 7th day in comparison with the control group and by 13.2% ($p>0.05$) in comparison with the 3rd day. The acini area has increased by 25.8% ($p>0.05$) on the 10th day in comparison with the control group; by 30.6% ($p<0.01$) in comparison with the 3rd day; by 20.2% ($p>0.05$) in comparison with the 7th day. The area of islets of Langerhans has increased by 55.5% ($p<0.001$) in comparison with the control group, by 56.3% ($p<0.001$) in comparison with the 3rd day; by 55.4% ($p<0.001$) in comparison with the 7th day. The results analysis found the correlation between the area of islets of Langerhans and acini $r=0.407$, $p<0.05$; between the area of islets of Langerhans and dehydration degree $r=0.708$, $p<0.001$; between acini area and dehydration degree $r=0.534$, $p<0.001$. It was found by morphologically that the presence of destructive changes in the pancreatic parenchyma, which progress as the degree of severity of dehydration.

Keywords: pancreas, islets of Langerhans, acini, dehydration.

Introduction
Water is the basis of internal environment of an organism [4, 5, 9, 22, 23]. The violation of water-electrolytic balance accompanies a number of pathological conditions and causes alteration of the organs and systems of an organism [7, 10, 21]. WHO informs that about 1.5 million people die annually from dehydration in the world [15, 18]. Understanding the vital role of water in a human body is the basis for comprehending the development mechanisms of pathological conditions [1, 2, 8, 25]. Endocrine system plays a key role in the system of water exchange control, providing an optimal volume of liquid in a body [14, 19]. All biochemical reactions, which occur in a human body and are associated with digestion, take place in the aquatic environment [3, 11, 24]. Pancreas pathology takes the lead in the structure of morbidity, disability and mortality among Ukrainian population [6, 12, 17, 20]. According to the research, the incidence of pancreas pathology is about 226 cases per 100,000 of Ukrainian population [17, 26].

Research aim: to carry out experimental research on mature laboratory rodents in order to identify histomorphometric changes in pancreas under the conditions of general dehydration of an organism and correlation of the studied groups.

Materials and methods
The experiment was carried out on 35 sexually mature...
white male rats, which were kept in inpatient conditions of vivarium. During the experiment, the experimental animals were kept in accordance with the regulations of European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1986), the principles of the Declaration of Helsinki adopted by the General Assembly of World Medical Association (1964-2000) "General ethical rules of experiments on animals", approved by the National Congress of Bioethics (Kyiv, 2001).

The animals were divided into two batches: control (5 rats) and experimental (30 rats). The experimental batch was divided into 3 groups with 10 rats in each group depending on dehydration degree. After reaching the correspondent degree of dehydration, the animals were released from the experiment under anesthesia on the 3rd day with mild dehydration, on the 7th day with moderate dehydration and on the 10th day severe dehydration.

For histological examination, pancreas was exposed by midline laparotomy and has been fixed in 10% neutral formalin solution for 24 hours. The experiment results were entered in the sample protocol. The passing of microtome knife and manufacture of paraffin blocks were carried out according to the established procedure [13, 16].

The sledge microtome МС-2 was used to produce paraffin serial sections of acini center with the thickness of 5-9 microns, they were stained with Haematoxylin and Eosin and also Van Gieson's stain was used. The obtained preparations were kept in accordance with the regulations of European Convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes (Strasbourg, 1997) and the guidelines of the World Health Organization (Geneva, 1999) on laboratory animal experiments.

Results

The average area of islets of Langerhans of various shapes and sizes, sharply separated from the exocrine cells by a thin layer of connective tissue, consisting of collagen, reticular and elastic fibers. There are cells which are firmly against each other in the center of the islets. These are β-cells of oval, sometimes round shape with light cytoplasm. There is an insignificant amount of α- and D-cells on the periphery of an islet, which are smaller in size. The average size of islets of Langerhans was 13934±688 microns.

Table 1. The average area of acini and islets of Langerhans.

<table>
<thead>
<tr>
<th>Experimental series</th>
<th>Control group/condition 0 (n=5)</th>
<th>1 group, mild dehydration (n=10)</th>
<th>2 group, moderate dehydration (n=10)</th>
<th>3 group, severe dehydration (n=10)</th>
<th>$P_0$</th>
<th>$P_1$</th>
<th>$P_2$</th>
<th>$P_3$</th>
<th>$P_4$</th>
<th>$P_5$</th>
<th>$F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>S of islets of Langerhans, microns</td>
<td>13934±688</td>
<td>1365±1434</td>
<td>13960±1571</td>
<td>31281±2858</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.01</td>
<td>&gt;0.05</td>
<td>&gt;0.01</td>
<td>&lt;0.01</td>
<td>23.78</td>
</tr>
<tr>
<td>S of acini, microns</td>
<td>983.4±63.5</td>
<td>920.2±121.3</td>
<td>1059±63</td>
<td>1326±70</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.01</td>
<td>&gt;0.05</td>
<td>4.600</td>
</tr>
</tbody>
</table>

Note: $P_0$ - statistical significance of differences between groups 0 and 1; $P_1$ - statistical significance of differences between groups 0 and 2; $P_2$ - statistical significance of differences between groups 0 and 3; $P_3$ - statistical significance of differences between groups 1 and 2; $P_4$ - statistical significance of differences between groups 1 and 3; $P_5$ - statistical significance of differences between groups 2 and 3.
The 10th day of the study demonstrated the significant structural changes in the exocrine and endocrine part of pancreas parenchyma. The gland structure when stained with haematoxylin and eosin and using Van Gieson's stain preserve lobulation, but most of the acini lose sharp contours due to swelling of the connective tissue. There is epithelium desquamation, advanced fibrosis around the excretory ducts. There are some areas of focal angiomatosis. There are perivascular leukocytic infiltrations and edema (Fig. 3).

Islets of Langerhans are of irregular shape, large in size due to hydropic dystrophic changes. There is lesser quantity of β-cells located in the islet center, the nuclei of the latter are of high density, hyperchromatic, between which the connective tissue is diagnosed due to edema (Fig. 4).

The area of islets of Langerhans has increased by 55.5% (p<0.001) in comparison with the control group, by 56.3% (p<0.001) in comparison with the 3rd day; by 55.4% (p<0.001) in comparison with the 7th day. The acini area has increased by 25.8% (p<0.05) on the 10th day in comparison with the control group; by 30.6% (p<0.01) in comparison with the 3rd day; by 20.2% (p>0.05) in comparison with the 7th day.

The results analysis found the correlation between the area of islets of Langerhans and acini r=0.407, p<0.05; between the area of islets of Langerhans and dehydration degree r=0.708, p<0.001; between acini area and dehydration degree r=0.534, p<0.001.
Discussion

In the conditions of general dehydration, changes in the histostructure of the parenchyma were found in all experimental series. The severity of the destructive changes in the exo- and endocrine parenchyma and microcirculatory bloodstream is progressing as the degree of severity of dehydration increases [4]. There is a large amount of data on the effect of various exogenous factors on the parenchyma of the pancreas in the literature, special attention is paid to the effects of alcohol and narcotic substances [1, 3]. The authors note the expression of degenerative changes in glandular cells and proliferation of connective tissue, obliteration and the phenomenon of endarteritis are observed in the vessels. In the excretory ducts, periductal fibrosis and epithelial proliferation are detected. Scientists have noted a decrease in the islets of Langerhans due to their wrinkling. A significant amount of work is devoted to the study of the effect of nicotine, in which the authors note the edema of cells and the compaction of nuclei with cell pyknosis. Taking into account a small number of studies in which the authors studied the effect of dehydration on the pancreatic parenchyma and their contradictory nature, we decided to conduct research in this direction.

The prospects for further research suppose the changes study in pancreas parenchyma under the conditions of intracellular dehydration.

Conclusions

1. The analysis of pancreas morphometric data under the conditions of general dehydration showed that the histostructure of gland parenchyma undergoes changes in all experimental groups. The morphological structure proved that destructive changes in both the exocrine and endocrine parenchyma and the microcirculatory bloodstream progress with the severity degree of dehydration.

2. The significant increase in acini area and islets of Langerhans occurs under the condition of severe dehydration. The results comparison of mild and moderate dehydration in comparison with the control group has not shown significant differences. One can suppose that it was caused by adaptive-compensatory mechanisms.

3. A direct connection is established between dehydration degree and the area of acini and islets of Langerhans.

References


ГІСТОМОРФОМЕТРИЧНА ОЦІНКА ЗМІН АЦИНУСІВ ТА ОСТРИВІВ ЛАНГЕРГАНСА ПІДШЛУНКОВОЇ ЗАЛОЗИ ЗА УМОВ ЗАГАЛЬНОГО ЗНЕВОДНЕННЯ ОРГАНІЗМУ

Ковчун В.Ю.

Зневоднення супроводжує ряд патологічних станів і викликає перестройку органів і систем організму. Метою дослідження було вивчення гістоморфометричних змін підшлункової залози за умов загального зневоднення організму. Результати дослідження свідчать про підвищення концентрації гематоксиліну-еозину в підшлунковій залозі та відповідної розмірності ацинусів та острівців Лангерганса. Площа ацинусів на 3 добу відносно інтактної групи зменшилася на 6,5% (р>0,05). Площа острівців зменшилася на 2% (р>0,05) відносно інтактної групи. На 7 добу відносно інтактної групи збільшилася на 0,2% (р>0,05) відносно групи контролю; на 2,2% (р>0,05) відносно 3 доби. Площа ацинусів збільшилася на 7,2% (р>0,05) відносно групи контролю і на 13,2% (р>0,05) відносно 3 доби. Площа ацинусів на 10 добу збільшилася на 25,8% (р<0,05) відносно групи контролю; на 30,6% (р<0,01) відносно 3 доби; на 55,5% (р<0,001) відносно групи контролю. Установлено наявність кореляційних зв'язків між площами ацинусів та острівців (r=0,407, р<0,05) та рівнем зневоднення (r=0,708, р<0,001). Морфологічно встановлено деструктивні зміни паренхими підшлункової залози, що прогресують за мірою зростання ступеня дегідратації.

Ключові слова: підшлункова залоза, острівці Лангерганса, ацинуси, зневоднення.


ГІСТОМОРФОМЕТРИЧНА ОЦІНКА ЗМІН АЦИНУСІВ ТА ОСТРИВІВ ЛАНГЕРГАНСА ПІДШЛУНКОВОЇ ЗАЛОЗИ ЗА УМОВ ЗАГАЛЬНОГО ЗНЕВОДНЕННЯ ОРГАНІЗМУ

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Ключові слова: підшлункова залоза, острівці Лангерганса, ацинуси, зневоднення.