



Investigation of Optical Density of Venous Blood Plasma in Acute Intraabdominal Infection in the Experiment

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Abstract

Background/Aims: Recognized laboratory criteria for acute intra-abdominal infection, in particular, general blood test, C-reactive protein, are nonspecific and insufficiently informative. We previously reported on the results of venous plasma optical density (ODVBP) measurements in emergency abdominal surgery. But the examined patients differed in the type of disease, sex, etc. Therefore, we conducted experimental studies to substantiate the possibility of using such a criterion.

Methods: 60 white nonlinear mature rats of both sexes, 180 to 200 g weight. To simulate acute intra-abdominal infection, intra-abdominal injection of 10 ml of 10% solution of autofaeces per 100 g of weight was performed. Blood from the jugular vein and pieces of peritoneum for histological examination was taken. The studies were performed before simulation, 6, 12, 24 and 48 h after simulation. ODVBP was examined on an Agilent Cary 100/300 Series UV-Vis spectrophotometer. Healthy animals were monitored for control.

Results: In healthy animals at a wavelength $\lambda = 310$ nm there is a specific maximum ODVBP, reaching 0.22 units. After simulation of acute intra-abdominal infection and the occurrence of serous peritonitis, there was a statistically significant increase in ODVBP at this wavelength. After the onset of purulent peritonitis, ODVBP also increased statistically significantly. Subsequently, after the spread of inflammation to the deep tissues of the abdominal wall, ODVBP was at a high level and statistically significantly exceeded the control values.

Conclusions

- In healthy white rats at a wavelength $\lambda = 310$ nm, a maximum ODVBP was detected, reaching 0.22 units, which does not depend on sex differences.
- After simulation of acute intra-abdominal infection and the development of serous inflammation of the peritoneum ODVBP this wavelength increased statistically significantly and reached 0.26 units.
- After the development of purulent peritonitis, ODVBP again increased statistically significantly and reached 0.36 units, and then, after the spread of inflammation to the deep layers of the abdominal wall, the indicators were at a high level without significant differences.
- The absolute parameters of the indicators differed from those determined in humans, but the ratios due to the presence of inflammatory changes in the abdominal cavity were preserved.

Keywords: Inflammation; Acute Intra-Abdominal Infection; Venous Blood Plasma; Optical Density of Venous Blood Plasma

Introduction

The basis of laboratory diagnosis of acute inflammatory intra-abdominal pathology is the determination of general analysis of blood and C-reactive protein [1-6]. But these criteria are nonspecific and often insufficiently informative [7]. Therefore, it is proposed to use new criteria [8,9]. We have studied the changes in the optical density of venous blood plasma (ODVBP) in patients with acute surgical diseases of the abdominal cavity [10]. We found diagnostically significant patterns. But the examined patients differed by sex, type of disease and so on. This did not allow to draw unambiguous conclusions about the possibility of using ODVBP. Therefore, we conducted experimental studies of changes in ODVBP in acute intra-abdominal infection (IAI), which is the basis for the emergence and progression of acute surgical diseases of the abdominal cavity [11].

Aim of the Study

To evaluate changes in ODVBP in acute IAI in the experiment.

Materials and Methods

60 white nonlinear mature rats of both sexes, weight 180 to 200 g. To simulate acute IAI performed a single puncture of the abdominal cavity and injected 10 ml of 10% solution of autofaeces per 100 g of weight [12]. Blood from the jugular vein and pieces of peritoneum for histological examination before IAI modeling, 6, 12, 24 and 48 hours after modeling were collected.

ODVBP was measured on an Agilent Cary 100/300 Series UV-Vis spectrophotometer. For histological examination, the tissues were fixed in 10% formalin solution, dehydrated in an ascending battery of alcohols, poured into paraffin. Sections were made on a microtome 5 μm thick. Dewaxed sections were stained with hematoxylin-eosin. Stained preparations were examined under a Delta-Optical Evolution 100 light-optical microscope. Data from healthy animals was monitored for control.

Carrying out the work, the generally accepted world and domestic norms of research in the field of biology and medicine were followed, namely: the provisions of the Vancouver Convention on Biomedical Research (1979, 1994). Removal of animals from the experiment was performed by decapitation. Inhalation sevoflurane anesthesia was used to anesthetize the animals.

Statistical calculation of research results was performed using Microsoft® Office Excel spreadsheets (build 11.5612.5703). Verifi-

cation of the law of distribution of samples for normality was carried out using the Shapiro-Wilk test. To test the hypothesis of mean equality, we used the Student-Fisher test for normally distributed samples and Wilcoxon’s criteria for samples whose distribution differed from normal.

Results and Discussion

We found (drawing) that healthy animals at a wavelength λ = 310 nm have a specific maximum ODVBP (D), reaching 0.22 units. There were no gender differences. Histological examinations showed the absence of pathological changes in the peritoneum.

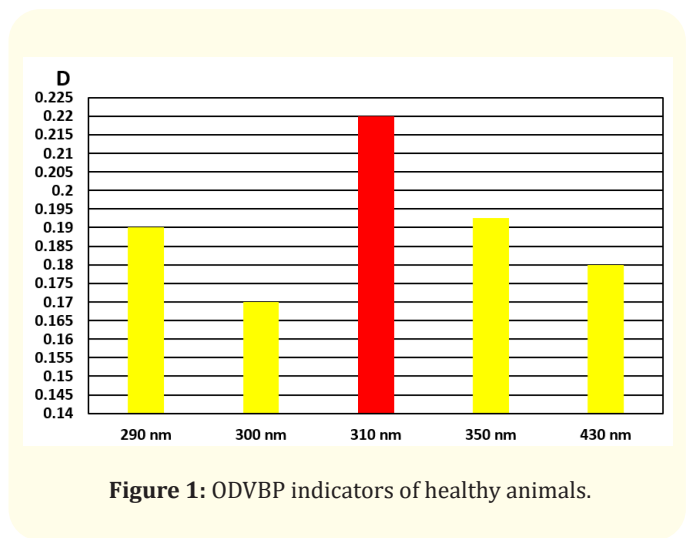


Figure 1: ODVBP indicators of healthy animals.

6 h after IAI simulation, the optical density index increased statistically significantly (table). Histological examinations during this period revealed signs of serous inflammation with elements of the initial formation of fibrinous exudate. There was focal desquamation of mesotheliocytes, peritoneal scar, some polymorphonuclear leukocytes in the peritoneum, small foci of fibrin threads. No signs of inflammation were found in the underlying muscle, indicating that the inflammation was localized only within the peritoneum.

Control	6 h	12 h	24 h	48 h
0.22 ± 0.01	0.26 ± 0.01	0.36 ± 0.04	0.35 ± 0.03	0.36 ± 0.05
	$P_{\text{control}} < 0.05$	$P_{\text{control}} < 0.01$ $p_{6h} < 0.05$	$P_{\text{control}} < 0.01$ $p_{6h} < 0.05$	$P_{\text{control}} < 0.01$ $p_{6h} < 0.05$

Table 1: Indicators of ODVBP animals at a wavelength λ = 310 nm during the experiment.

12 hours after the IAI simulation, the ODVBP indicator increased again and statistically significantly outperformed both the 6 h indicator and, especially, the control indicator. Histological examination during this period revealed signs of purulent inflammation. There was a large number of polymorphonuclear leukocytes, desquamation of mesotheliocytes and peritoneal edema. This indicates the progression of inflammation in the abdominal cavity.

24 and 48h after IAI simulation, ODVBP indicators did not change significantly. The parameters of the indicators statistically significantly outweigh both the control and indicators for 6 hours. Histological examination during this period revealed signs of purulent-fibrinous inflammation. There was a large number of polymorphonuclear leukocytes among fibrin threads, continuous desquamation of mesotheliocytes and peritoneal edema. There was edema of the stroma in the adjacent muscle, as well as focal penetration of polymorphonuclear leukocytes and focal deposits of fibrin. This indicates both the progression of the inflammatory process in the peritoneum, and the involvement in the process of deep layers of the abdominal wall.

The absolute parameters of ODVBP indicators found in the experiment differ from those determined in humans [10]. But the ratios due to the IAI are maintained. This indicates the possibility of using such indicators for diagnosis in clinical settings.

Conclusion

- In healthy white rats at a wavelength $\lambda = 310$ nm, a maximum ODVBP was detected, reaching 0.22 units, which does not depend on sex differences.
- After simulation of acute intra-abdominal infection and the development of serous inflammation of the peritoneum ODVBP this wavelength increased statistically significantly and reached 0.26 units.
- After the development of purulent peritonitis, ODVBP again increased statistically significantly and reached 0.36 units, and then, after the spread of inflammation to the deep layers of the abdominal wall, the indicators were at a high level without significant differences.
- The absolute parameters of the indicators differed from those determined in humans, but the ratios due to the presence of inflammatory changes in the abdominal cavity were preserved.

Authors' Contribution

A.I. Shurma: Obtaining data for analysis, writing the text of an article.

F.V. Grynchuk: Research design development, data analysis.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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