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# COMPARATIVE CHARACTERISTICS OF THE HEMOMICROCIRCULATORY BED OF THE SCIATIC NERVE TRUNK IN RATS WITH SINGLE ADMINISTRATION OF CRYOPRESERVED PLACENTA AND IN ACUTE ASEPTIC INFLAMMATION

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***Objective.*** *To study the response of the sciatic nerve trunk's hemomicrocirculatory bed to a single administration of cryopreserved placenta and intraperitoneal administration of λ -carrageenan.*

***Material and methods.*** *An experimental study was performed on the sciatic nerve trunk of 100 sexually-mature rats. Histological research methods were used.*

*It was established that when transplanting a cryopreserved placenta, all parts of the hemomicrocirculatory bed (HMCB) respond. Thus, the resistive part of the sciatic nerve trunk HMCB during cryopreserved placenta transplantation was characterized by a gradual increase in the mean diameters with the maximum value on the 5th-7th days and their complete recovery on the 10th day of the study. In the simulation of acute aseptic peritonitis there is a sharp decrease in diameters on the 2nd-3rd days, followed by their increase on the 5th-14th days and recovery on the 30th day.*

***Results.*** *In transplantation of cryopreserved placenta, the exchange link of the HMCB reacted significantly by increasing the mean diameter of the capillaries on the 5th day. In the simulation of acute aseptic peritonitis, the mean diameter of the capillaries increased on the 1st day and did not return to the control group limits on the 30th day of the study. Capacitive link responded to transplantation of cryopreserved placenta by an increase in diameter with the maximum value on the 5th day and recovery on the 10th day of the study ($p < 0.05$). When simulating acute aseptic peritonitis, there is also an increase in diameters with the maximum value on the 7th day. On the 30th day of the study, the index value did not reach the limits of the control group.*

***Conclusions.*** *A single administration of cryopreserved placenta fragment causes short-term changes in the hemomicrocirculatory bed with the maximum values on the 5th-7th days of the study, in contrast to a single injection of 5 mg of λ-carrageenan (Sigma - USA), which leads to reactive inflammation and lasts for over 30 days.*

***Key words:*** *trunk, sciatic nerve, hemomicrocirculatory bed, cryopreserved placenta, aseptic inflammation.*

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**ПОРІВНЯЛЬНА ХАРАКТЕРИСТИКА ГЕМОМІКРОЦИРКУЛЯТОРНОГО РУСЛА СТОВБУРА СІДНИЧНОГО НЕРВА ЩУРІВ ПРИ ОДНАРАЗОВОМУ ВВЕДЕННІ КРІОКОНСЕРВОВАНОЇ ПЛАЦЕНТИ ТА ГОСТРОМУ АСЕПТИЧНОМУ ЗАПАЛЕННІ**

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***Мета роботи –*** *вивчити реакції гемомікроциркуляторного русла сідничного нерва на однократне введення кріоконсервованої плаценти і внутрішньочеревне введення λ-карагенену.*

***Матеріал і методи.*** *Проведено експериментальне дослідження стовбура сідничного нерва на 100 статевозрілих щурах. Застосовували гістологічні методи дослідження.*

***Результати.*** *Встановлено, що при трансплантації кріоконсервованої плаценти реагують усі ланки гемомікроциркуляторного русла (ГМЦР) стовбура сідничного нерва. Так, резистивна ланка ГМЦР стовбура сідничного нерва при трансплантації кріоконсервованої плаценти характеризувалася поступовим збільшенням показників середніх діаметрів із максимальним значенням на 5-7-му доби та повним відновленням їх на 10-ту добу дослідження. При моделюванні гострого асептичного запалення очеревини відзначається різке зменшення діаметрів на 2-3-тю доби з наступним збільшенням їх протягом 5-14 діб та відновленням на 30-ту добу.*

*При трансплантації кріоконсервованої плаценти обмінна ланка ГМЦР суттєво реагувала збільшенням середнього діаметра капілярів на 5-ту добу. При моделюванні гострого асептичного запалення очеревини середній діаметр капілярів збільшився на 1-ту добу і не повернувся до значень показників контрольної групи на 30-ту добу дослідження.*

*Ємнісна ланка реагувала на трансплантацію кріоконсервованої плаценти*

***Ключові слова:*** *стовбур, сідничний нерв, гемомікроцир-куляторне русло, кріоконсервована плацента, асептичне запалення.*

Клінічна та експеримен-тальна патологія 2020. Т.19, №2(72). С.39-45.

*збільшенням діаметрів з максимальним значенням на 5-ту добу і відновленням на 10-ту добу дослідження (p<0,05). При моделюванні гострого асептичного запалення очеревини відзначається також збільшення діаметрів з максимальним значенням на 7-му добу. На 30-ту добу дослідження показник не сягнув меж контрольної групи.*

***Висновок.** Одноразове введення фрагменту кріоконсервованої плаценти викликає короткотривалі зміни в гемомікроциркуляторному руслі стовбура сідничного нерва з максимальними значеннями на 5-7-му добу дослідження, на відміну від одноразового введення 5мг λ-карагенену ((Sigma, США), яке призводить до реактивного запалення, що триває протягом всього експерименту більше 30 діб.*

***Ключевые слова:***
*ствол, седалищный нерв, гемомикроциркуляторное русло, криоконсервированная плацента, асептическое воспаление.*

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**СРАВНИТЕЛЬНАЯ ХАРАКТЕРИСТИКА ГЕМОМИКРОЦИРКУЛЯТОРНОГО РУСЛА СТВОЛА СЕДАЛИЩНОГО НЕРВА КРЫС ПРИ ОДНОРАЗОВОМ ВВЕДЕНИИ КРИОКОНСЕРВИРОВАННОЙ ПЛАЦЕНТЫ И ОСТРОМ АСЕПТИЧЕСКОМ ВОСПАЛЕНИИ**

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***Цель работы –** изучить реакции гемомикроциркуляторного русла ствола седалищного нерва на однократное введение криоконсервированной плаценты и внутрибрюшное введение λ-карагенена.*

***Материал и методы.** Проведено экспериментальное исследование ствола седалищного нерва на 100 половозрелых крысах. Применяли гистологические методы исследования.*

***Результаты.** Установлено, что при трансплантации криоконсервированной плаценты реагируют все звенья гемомикроциркуляторного русла (ГМЦР). Так, резистивное звено ГМЦР ствола седалищного нерва при трансплантации криоконсервированной плаценты характеризовалось постепенным увеличением показателей средних диаметров с максимальным значением на 5-7-е сутки и полным восстановлением их на 10-е сутки исследования. При моделировании острого асептического воспаления брюшины отмечается резкое уменьшение диаметров на 2-3-е сутки с последующим увеличением их в течение 5-14-х суток и восстановлением на 30-е сутки.*

*При трансплантации криоконсервированной плаценты обменное звено ГМЦР существенно реагировало увеличением среднего диаметра капилляров на 5-е сутки. При моделировании острого асептического воспаления брюшины средний диаметр капилляров увеличился на 1-е сутки и не вернулся к значениям показателей контрольной группы на 30-е сутки исследования.*

*Емкостное звено реагировало на трансплантацию криоконсервированной плаценты увеличением диаметров с максимальным значением на 5-е сутки и восстановлением на 10-е сутки исследования (p <0,05). При моделировании острого асептического воспаления брюшины отмечается также увеличение диаметров с максимальным значением на 7-е сутки. На 30-е сутки исследования показатель не достиг границ контрольной группы.*

***Вывод.** Однократное введение фрагмента криоконсервированной плаценты вызывает кратковременные изменения в гемомикроциркуляторном русле ствола седалишного нерва с максимальными значениями на 5-7-е сутки исследования, в отличие от однократного введения 5 мг λ-карагенена ((Sigma, США), которое приводит к реактивному воспалению, продолжающемуся в течение всего эксперимента более 30 суток.*

The work is a fragment of the research project "Ukrainian Medical Stomatological Academy" at the Ministry of Health of Ukraine "Experimental and morphological study of the cryopreserved specimens of cord blood and embryo-fetal placental complex (EFPC), diphereline and 1% methacrylic acid ester action on morphofunctional status of certain internal organs", state registration No. 0119U102925, the author is a contributor of the above project.

In the general pathological process of the human body, and consequently, in the practicing physician's activity, inflammatory process occupies one of the first places. The action of the damaging factor causes a local protective response in the form of inflammation and involves participation of the whole body, constituting the main pathogenesis of the disease as a whole. The main morphological picture of the affected organ also consists of the inflammation causes [1, 3, 4].

Thus, the inflammatory process in the sciatic nerve trunk can develop both in its fibers and in the structure of the membranes, three links of the hemomicrocirculatory bed also undergo structural

changes [6, 8].

Hemomicrocirculatory bed (HMCB) is one of the main links that ensures metabolism not only in nerve tissues but also in the body as a whole, and is among the first to respond to administration of various active substances of different origin into the body by increasing or decreasing vascular walls and lumen (in arterioles, capillaries, venules). In addition, HMCB responds to the manifestations of inflammatory processes and various environmental, toxic factors, biologically active additives, food stabilizers, which are harmful to living organisms [6].

Thus, at present in medicine there is an unsolved issue of obtaining effective and at the same time inexpensive biological products that could perform the substitutional function of a pathologically altered organ [2,5]. Long-term studies have shown that cryopreserved placenta can act as such a drug. These studies have also shown that cryopreserved placenta is an effective biostimulator and has immunocorrective, antioxidant, radioprotective and hepatoprotective properties [7, 9].

The anti-inflammatory effect of this drug is to limit alternative and to enhance reparative processes [9, 10].

The purpose of the work was to study the response of the sciatic nerve trunk's hemomicrocirculatory bed to a single administration of cryopreserved placenta and intraperitoneal administration of λ-carrageenan.

**Materials and methods**

The object of the experimental study was the sciatic nerve trunk sampled from 100 adult male Wistar rats. The experiment was carried out in compliance with the "Rules for the Use of Laboratory Experimental Animals" (2006, Annex 4) and the Declaration of Helsinki on Humane Treatment of Animals.

Animals were divided into three groups: group I – control, 10 animals 10; group II - 45 animals, which were once injected subcutaneously with a fragment of cryopreserved placenta amounting 05 $cm^3$; group III - 45 animals, which were simulated with acute experimental peritonitis in rats by intraperitoneally administered 5 mg of λ-carrageenan (Sigma - USA) in 1 ml of normal saline per animal.

Animals were sacrificed by overdose of thiopental anesthesia according to the established terms (days 1, 2, 3, 5, 7, 10, 14, 21, 30). Fragments of the sciatic nerve trunk were embedded into paraffin according to conventional methods and histological sections were made, which were stained with: hematoxylin-eosin according to Van Gizon and Hart (paraffin sections), with polychrome stain, methylene blue.

To calculate the results, the diameter in the HMCB vessels of the sciatic nerve trunk was measured. We used a microscope with Olympus C 3040-ADU digital photomicrographic attachment with programs adapted for research data (Olympus DP - Soft, license No. VJ285302, VT310403, 1AV4U13B26802) and BIOREX 3 (serial No. 5604). Mathematical processing of the data was performed using standard methods of variation statistics: calculation of mean values (M), errors of mean values (m), Student's criterion (t-test). Discrepancies at ($p < 0.05$) were considered reliable.

**Results of the study and their discussion**

The morphometric parameters analysis of the resistive link of the sciatic nerve trunk HMCB in a single administration of cryopreserved placenta (group II) did not change equally during the experiment. Comparative analysis of group II between the terms of the study showed (fig. 1) that on the 2nd day the arterioles diameter did not increase significantly

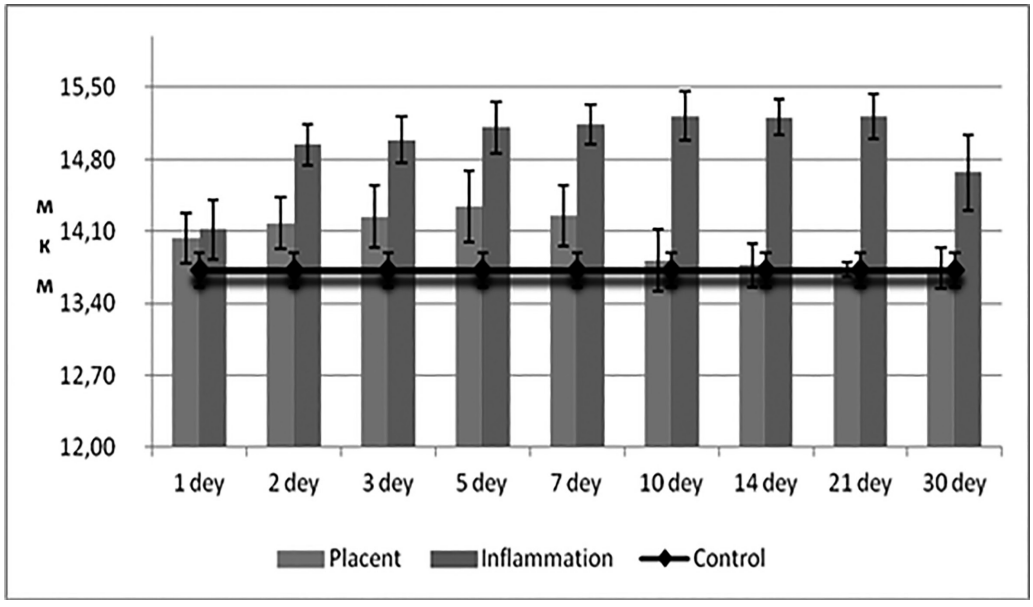


**Fig. 1. Comparative characteristics of the mean diameter in the arterioles of the sciatic nerve trunk.**

compared to the 1st day (p> 0.05). Within 3-5 days, this index increased, but we did not find a significant difference between these terms. On the 7th day, the index decreased slightly, but when comparing it to the previous term, no significant difference was found (p> 0.05). On the 10th day, the mean value of the arterioles diameter decreased insignificantly compared to the previous term (p> 0.05). Within 10-30 days, this index was decreasing, but the difference reliability was not significant.

Comparing the mean diameter of arterioles in group II to the similar index of the control group, we found an increase in the index value, but the difference was significant only during days 2-7.

Studying the mean diameter of arterioles between the terms of the study in the group of animals that were induced aseptic inflammation of the peritoneum (group III), we found the following changes: on day 2, we found a significant increase compared to day 1 (p <0,05); on the 3rd day, the value of this index increased slightly, the significance of the difference compared to the 2nd day was insignificant, and in comparison with the 1st day - significant at p <0.05. Further analysis showed an increase in the index on the 5th day, the difference reliability was p> 0.05. During the 5th-14th days, the index continued to be without increase, but the difference reliability between these four terms was not significant (p> 0.05). On the 21st day, the value remained at the level of the14th day. On the 30th day the index value decreased, but compared to the 21st day we have not found a significant difference between these terms.

Analysis of the arterioles mean diameter when comparing group III to the control group animals, showed an increase in this parameter. If on the 1st day this decrease was not significant, then on the 2nd and the 3rd days we found its significant increase at p <0.05. During the 5th-21st days, the mean diameter of the arterioles was significantly larger in group III, compared to the similar index of the control group, with the highest value on the 14th day. When comparing the index values on the 30th day to the control group, we found a slight decrease in the index value.

The exchange link of the sciatic nerve trunk HMCB with a single administration of a cryopreserved placenta fragment did not change equally. Analysis of the capillaries mean diameter is presented in fig. 2.

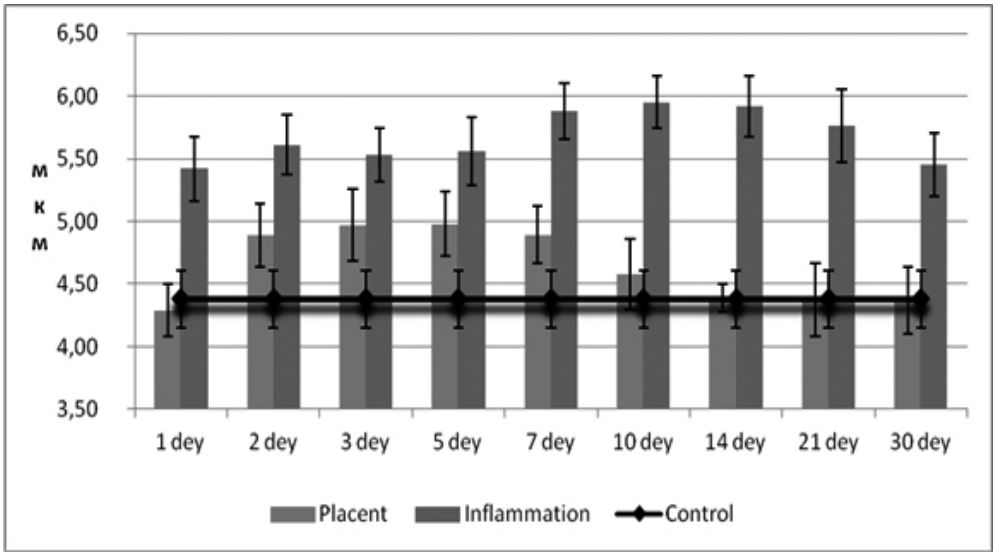


**Fig. 2. Comparative characteristics of the capillaries' mean diameter of the sciatic nerve trunk.**

In animal group 2 we found an increase in the index value on the 2nd day, the discrepancy between the previous study period was reliable (p <0.05). Within 3-5 days we found a slight increase in this parameter, but the difference reliability between the terms was absent. Starting from day 7, we found a decrease in this parameter, but this decrease was not significant. Starting from the 10th day, a decrease in this index value was found, compared to the 7th day. On the 14th-30th days, there was no significant fluctuation of the index within 1 day.

Comparing group II to the control group animals, we found a significant increase in the capillaries' mean diameter on the 2nd-7th days at p <0.05, with a maximum value on the 5th day of the study. Starting from the 10th up to the 30th day, the index value was within the control group limits.

In the simulation of acute aseptic peritonitis in rats, it was found that the mean diameter of the capillaries during the experiment changed, the data are presented in fig. 2. On the 1st day, this index increased as much as possible. We found a reliable difference (p <0.05). On the 3rd day, it did not increase significantly compared to the 2nd day. Further analysis showed an increase in the index value on the 5th day, compared to the previous term, the reliability was p> 0.05. The index continued to increase during the 5th-14th days, the difference reliability between these four terms was not revealed. On the 21st day, the maximum value of the index was observed. On the 30th day, this figure decreased, the

difference with the previous term was not significant (at p> 0.05).

When comparing the control and group III of animals, we found that on the 1st-3rd days the mean diameter of the capillaries increased. This increase was significant. On the 5th-14th days, the index value was significantly higher between groups. The difference reliability between the groups was high (p <0.05). On the 21st day, the index grew as high as possible. On the 30th day, the index value decreased, but was reliably high compared to the control group.

Carrying out the statistical analysis of the vessels mean diameter in the capacitive link of the sciatic nerve trunk, the following changes were revealed. The results are presented in fig. 3.

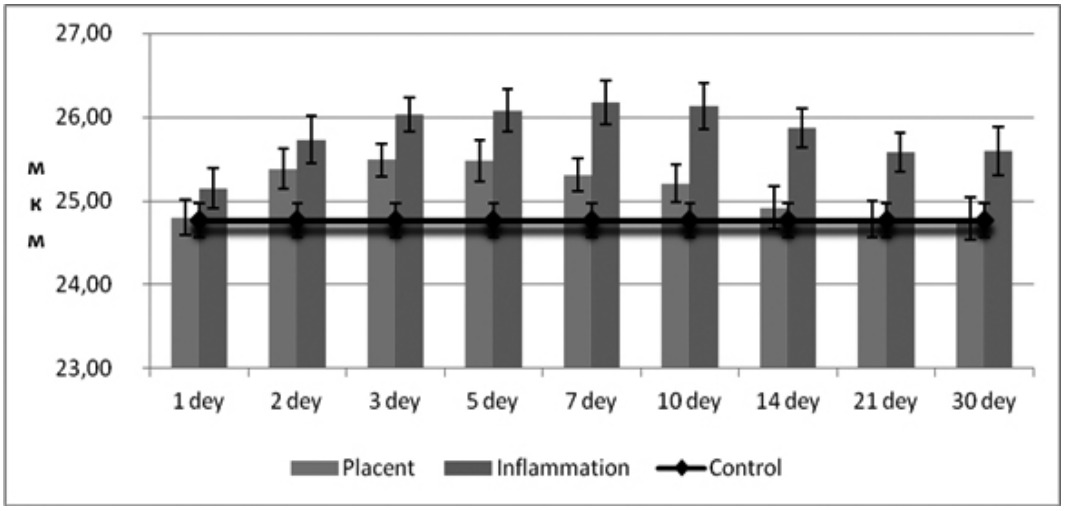


**Fig. 3. Comparative characteristics of the mean diameter of the sciatic nerve trunk venules.**

Thus, in group 2 of animals, when comparing the indices of the 2nd and the 3rd days, we found an increase in the index value. The difference between the terms of the study was significant when comparing the 1st and the 3rd days (at p <0.05). On the 5th day, this index value was the maximum, but, comparing it to the previous term did not reveal a significant difference. On the 7th day there was a decrease in this index, but the difference with the previous term was not significant. Starting from the 10th day, a reliable decrease in this parameter was found, compared to the 7th day. This index decreased during the 14th-30th days, but the difference with the previous term was insignificant. Comparing the same group with the control animals group, we found a significant difference only for indices on the 2nd-7th days of the study (p <0.05).

Studying the index of group III animals, which were induced acute aseptic inflammation of the peritoneum, we found the following changes between the terms of the study. On the 2nd day, we found an increase compared to the 1st day (p <0.05). Within the 3rd-10th days there was a further increase in the mean diameter of the venules. If no difference was found between these terms, then compared to the 1st day the index value was probably higher. On the 21srt-30th days there was a decrease in diameters, but no significant difference between them was found.

When comparing the control and group III animals, we found that on the 1st day the index value did not differ from the control group, and on the 2nd-21st days a reliable difference when comparing the two groups was revealed. On the 30th day, the index value decreased, but did not reach the limits of the control group.

**Conclusions**

**1.**Resistive part of the HMCB of the sciatic nerve trunk during transplantation of cryopreserved placenta was characterized by a gradual increase in mean diameters with a maximum value on the 5th-7th days and their complete recovery on the 10th day. When modeling acute aseptic peritonitis there is a sharp decrease in the diameters on the 2nd-3rd days, followed by their increase on the 5th-14th days and recovery on the 30th day.

**2.**Thus, during the cryopreserved placenta transplantation, the exchange link of the HMCB reacted significantly by increasing the mean diameter of the capillaries on the 5th day. In the simulation of acute aseptic peritonitis, the mean diameter of the capillaries increased on the 1st day and did not return to the control group limits on the 30th day of the study.

**3.**Thus, transplantation of cryopreserved placenta causes an increase in the diameter of the capacitive link of the hemomicrocirculatory bed with the maximum value on the 5th day and recovery on the 10th day of the study (p <0.05). In the simulation of acute aseptic peritonitis, there is also an increase in diameters with the maximum value on the 7th day. On the 30th day of the study, the index value did not reach the limits of the control group.

**4.**Administration of a single fragment of cryopreserved placenta causes short-term changes in the hemomicrocirculatory bed with the maximum values on the 5th-7th days of the study, in contrast to a single administration of 5 mg of λ-carrageenan (Sigma - USA), which leads to reactive inflammation and lasts throughout the experiment for over 30 days.

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