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 сідницького нерва шурів при одноразовому введенні кріоконсервованої плаценти та гострому асептичному запаленні

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Мета роботи – вивчити реакції гемомікроциркуляторного русла сідницького нерва на однократне введення кріоконсервованої плаценти і внутрішньочеревне введення λ-карагенену;

Матеріал і методи. Проведено експериментальне дослідження стовбура сідницького нерва на 100 статевозрілих шурах. Застосовували гістологічні методи дослідження.

Результати. Встановлено, що при трансплантації кріоконсервованої плаценти відбуваються значні зміни гемомікроциркуляторного русла (ГМЦР) стовбура сідницького нерва.

При трансплантації кріоконсервованої плаценти відбуваються значні зміни гемомікроциркуляторного русла (ГМЦР) стовбура сідницького нерва.

Ключові слова: стовбур, сідничий нерв, гемомікроциркуляторне русло, кріоконсервована плацента, асептичне запалення.
Оригінальні дослідження

СР АВНИТЕЛЬНА ХАР АКТЕРИСТИКА ГЕМОМИ КРУКАЛЬНОГО ПУСЛА СТВОЛА СЕДАЛИЩНОГО НЕРВА КРЫС ПРИ ОДНОР АЗОВМ 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. Применили 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 остrego 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 значительно реагировало увеличением среднего диаметра капилляров на 5-е сутки. При моделировании остrego 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 (р <0,05). При моделировании остrego асептического воспаления брюшины увеличивается 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 краткосрочные изменения в гемомикроциркуляторном русле ствола седалищного нерва с максимальным 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.

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

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
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 ι-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 cm³; group III - 45 animals, which were simulated with acute experimental peritonitis in rats by intraperitoneally administered 5 mg of ι-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...
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 the 14th 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.

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.

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
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-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-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.

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.

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 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 \( \lambda \)-carrageenan (Sigma - USA), which leads to reactive inflammation and lasts throughout the experiment for over 30 days.
Оригінальні дослідження

Список літератури

1. Біліш С.М. Вплив криоконсервованої плазенти на морфофункціональний стан екзокриноцитів воротарних залоз шлунка при запальних процесах. Вісник проблем біології та медицини. 2013;2(1):224-7.

2. Біліш С.М. Морфометрична характеристика стінки кардіального відділу шлунка інтенсивних шурів при гострому гастриті, введенні препарату "Платекс плазентарний" та їх поєднаної дії. Світ медицини та біології. 2012;3:7-10.

3. Болощй С. М., Аквальній Р. В. Воспалення. Мобілізація клеток і клінічні ефекти. Москва: Вищимо; 2008. 240 с.

4. Волошинова О.В., Шепітько В.І., Клипаченко І.В., Полив'яна О.А. Клініка вагітності. Українська медицина. 2015;3:82-5.

5. Волошинова ОВ. Структурна організація клітин печінки і їх корекція з криоконсервованої плазенти в експериментальному перитоніті. East European Scientific Journal. 2019;10(2):23-8.

6. Гукас І.В. Динаміка змін гемомікроциркуляторного русла тонкої кишки при гострому ентериті. Світ медицини та біології. 2013;3:82-5.

References

1. Bilash SM. Vplyv kriokonservovanoi platently na morfologichni protsesi u oblasti pylorico-duodenal'noho istochnika. [Influence of cryopreserved placenta on the structure of pyloroduodenal area]. Problemy Donevh. 2013;2(1):224-7. (in Ukrainian).

2. Bilash SM. Morfometrichna kharakterystyka stiny kardial'noho vididi shlunku stetskykh shuriv pry hostromu hostromu pattom, vidaenni preparatu «Platex plazentarnyi» ta yikh pojednanoi di. [Morphometric description of cardial part of stomach’s wall of intact rats, at acute gastritis, introduction of preparation “Platex placental” and their united action]. World of Medicine and Biology. 2012;3:7-10. (in Ukrainian).

3. Bolotskij SM, Avatljion RR. Vospalenie. Mobilizatsiya kletok i klinicheskie effekty [Inflammation. Cell Mobilization and Clinical Effects]. Moscow: Binomo; 2008. 240 p. (in Russian).

4. Voloshina EV, Shepitko VI, Kriokonservovana storonowskaya plazenta. Vplyv na pervy vnedreniya qriokonservovanoi plazenty u schuriv [Characteristics of the sciatic nerve trunk structural components with administering the cryopreserved placent in rats]. World of Medicine and Biology. 2018;4:202-7. doi: 10.26724/2079-8334-2018-4-66-149-151 (in Ukrainian).

5. Voloshyna OV. Structural organization of rat hepatic cells and their correction with cryopreserved placenta in experimental peritonitis. East European Scientific Journal. 2019;10(2):23-8.

6. Gunas IV. Dynamika zmin hemomikrotsyrkuliatornogo rusla tonkoy kishki pry hostromu enterite [The dynamics of small intestine hemomicrocirculatory stream alterations in acute enteritis]. World of Medicine and Biology. 2015;3:82-5. (in Ukrainian).

7. Sviriduk RV, Shepitko VI, Shepitko IV, Klypachenko IV. Kharakterystyka strukturnykh komponentiv stovbura sidnychnoho nervera pry vvedeni kriokonservovanoi platenty u schuriv [Characteristics of the sciatic nerve trunk structural components with administering the cryopreserved placenta in rats]. World of Medicine and Biology. 2018;4:202-7. doi: 10.26724/2079-8334-2018-4-66-202-207 (in Ukrainian).

8. Sipliviy VA, Grinchenko SV, Gorgohl NI, Doschenko WV, Evtushenko AV. Patomorfologicheskie osobennosti gemomikrotsyrkuliatornogo rusa tonkoy i tolstoy kishki pri ostrom peritonite [Pathomorphological peculiarities of hemomicrocirculatory bed of small and large bowel in an acute peritonitis]. Klinichna khirurhiia. 2014;1:61-3. (in Russian).

9. Shepitko VI, Yeroshenko HA, Yurchenko TM, Shepitko IV, Klipachenko IV. Korehuiucha diia transplantatsii kriokonservovanoi plazenty u schuriv [Improving the action of cryopreserved placenta transplant in rats]. World of Medicine and Biology. 2015;3:82-5. (in Ukrainian).

10. Yakushko OS. Korehuiucha diia transplantatsii kriokonservovanoi plazenty u perebih hostroho aseptichnogo nevrytyu [Improving the action of cryopreserved placenta on flow of acute aseptic neuritis of optic nerve of rats]. World of Medicine and Biology. 2018;4:202-7. doi: 10.26724/2079-8334-2018-4-66-202-207 (in Ukrainian).

11. Shepits'ko VI, Verohoschenko HA, Yurchenko TM, Shepits'ko IV. Kriokonservovana platenta. Vplyv na pervykh eksperimental'noho nevryty [Influence of cryopreserved placenta on the course of experimental sciadadenitis]. Poltava: Kopir Servis; 2013. 122 p. (in Ukrainian).

12. Voloishyna OV, Shepitko VI. Morfologichna struktura hepatotsytiv ta klinichni effekty [Morphological structure of hepatocytes and clinical effects]. Moscow: Binomo; 2008. 240 p. (in Russian).

13. Bilash SM. Vpliv kriokonservovanoi platently na morfoklinichni protsesi u oblasti pylorico-duodenal’noho istochnika. [Influence of cryopreserved placenta on the morphological processes in the pyloroduodenal area]. Problemy Donevh. 2013;2(1):224-7. (in Ukrainian).

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