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Research Article

Optic Nerve Regeneration after Traumatic Crush

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Abstract

The aim was to activate regenerative processes in the optic nerve traumatic crush at high doses of corticosteroids. It has been used 6 mature rabbits (Group injured), which made damage the optic nerve. 6 rabbits (treated group) on the second day after the injury were treated with the use administration of methyl prednisolone. At 14 days after treatment of intracranial optic nerve improves microcirculation observed, accompanied by a decrease in swelling. There was detected remielinisation regeneration of these fibers. There are young mitochondria in the axoplasma. There were formed microtubules and structured neuro filaments, which is an early sign of regenerative processes of the optic nerve.

Conclusion: Consequently found that for traumatic optic nerve damage high doses of corticosteroids for 14 days results in improvement of microcirculation reduce swelling, remielinisation and activation of regeneration.

Keywords: *optic nerve traumatic crush; regeneration; remyelinisation; high doses of corticosteroids.*

Introduction

The research on the possibilities of regeneration of the optic nerve turns attention by scientist for many decades. It is known that the regenerative processes in the eye occur in three stages: alterations, changes of microcirculation and cell proliferation [1]. However regenerative mechanisms of optic nerve's different parts are still not clear.

The most popular meaning is that in normal retinal ganglion cells are not able to regenerate after damage to the optic nerve. For example Marcus Ohlsson [2] in 2003 explains that an imbalance between inflammatory and anti-inflammatory factors damaged optic nerve reveals and reduces the capacity of its recovery.

But nowadays the most progressive scientists are looking for possibility to make optic nerve to regenerate. According to experimental studies it is known that reducing the death of retinal ganglion cells after optic nerve injury in mammals can achieve by applying inhibitory of apoptosis and growth factors that distinguish peripheral nerves [3,4]. Stimulation of regenerative processes can occur because of macrophages intraocular system activation [2].

Guy J Ben Simon. [5] showed that secondary indirect damage to the optic nerve arises as a result of exposure neurotoxins secreted by retinal ganglion cells. The brain neurotrophic factor's concentration increases in the ganglion cells on the affected side and decreases on the opposite after brain damage. While ganglion cells produce their own protective factor that ensures their survival. This neuroprotective effect is inhibited by high doses of glucocorticoids and provides opportunities for treatment traumatic optic neuropathy. In these cases proved the efficacy of high-dose corticosteroids (30 mg/kg) [6].

Thus the study regenerative processes that occur in the optic nerve under the influence of corticosteroids require detailed studies that will optimize how they use and, if possible, to reduce their negative impact.

Aim: was to activate regenerative processes in the optic nerve traumatic crush at high doses of corticosteroids.

Material and Methods

6 mature rabbits (group injured) males, weighing 3.54 kg Soviet Chinchilla breeds were used as an experimental model. Additionally, 6 rabbits (treated group) on the second day after the injury were treated using a/m administration of methylprednisolone 30 mg/kg for 3 days, then the dose is gradually reduced. The control group consisted of 15 intact rabbits.

The modulation of right traumatic optic nerve damages was made [7] in the operating conditions Department of Human Anatomy Ivano-Frankovsk National Medical University of the rules of asepsis. Pets and removing them from the experiment was carried out in accordance with the "Requirements bioethics Helsinki Declaration on ethical regulation of medical research."

Both groups of animals injured were removed from the experiment using the guillotine after 2 weeks. Cranial part of both eyes the optic nerve was morphological examined. As a control, use the appropriate structure of the control group.

The material pieces were fixed in 2% osmium tetroxide solution, performed and contrasted by generally accepted method for electron microscopic examination. The study was performed on material electron microscope REM 125 K, the accelerating voltage of 75 kV, followed by photographing at magnifications of 1,200 to 25,000 times. Hemi thin sections, 1 mm thick, stained with 1% methylene blue solution. Hemi thin sections were examined under a light microscope MS 300 (THR) and photographed using Digital camera for microscope DCM 900 extension 1200h1600.

We conducted a morphometric study of electron for an objective assessment of the nerve fibers of the optic nerve of the rabbit. Negatives were scanned electron, translating into positive, and stored in the same format. Morphometry was performed on these specimens using software NIH USA "Image J" manually taking into account increases.

The measurements myelin membranes of axons and fibers in general were conducted. Index "g" determined by the formula: g = a/d, where A - area of the axon, d - area of a myelin fibers. The thickness of the myelin sheath was determined by the formula: l = D - d, where l - thickness of myelin, D - the average diameter of the fibers, d - average diameter of the axon.

Computer data processing was performed using Statistical Package Stat. Soft. Inc; Tulsa, OK, USA. Statistica 6.

Results

There were founded reduce swelling endoneural connective tissue at 14th day compared the group without treatment with treated group after experimental traumatic crush orbital modeling of the right optic nerve in rabbits. There swelling has stayed in the subperyneural area and around of micro vessels (Figure 1). The myelin nerve fiber (MNF) became round, oval, irregular satellite and polygonal shapes. Some MNF outer and inner contours of the myelin sheath (MS) were concentric, while others - the inner layers of myelin shaped protrusions of different shapes and heights that show evidence preservation degenerative changes of MNF [8]. The reactive changes observed on the opposite side of the lesion.

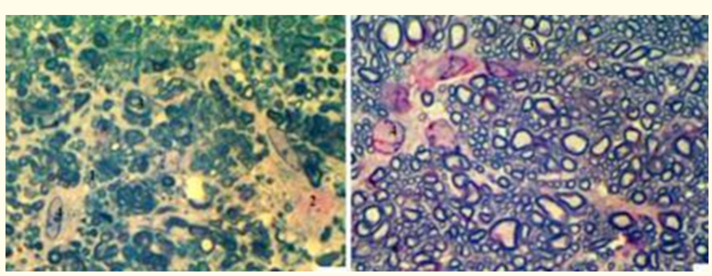

Figure 1: *The right sided in rabbits traumatic crush's intracranial part of right (a) and the left optic nerve (b) morph structure manifestations at14th day after use of high doses of corticosteroids. Hemi thin sections were stained with polychrome dye. Inc.: x1000.*
Notes: *1 - newly of MNF, 2 - newly formed collagen fibers, 3 - destructively altered MNF, 4 - core fibroblast, 5 - reactive changes.*

The area of intracranial part of MNF of the right optic nerve decreased according to group without treatment's parameters (p = 0.006972). The index of g was statistically significant increased (p = 0.000423). This was indicated of fibers' remyelinisation.

There were manifested MNF, which MS consisted only of a few blades of myelin, that was expressly ordered (Figure 2) in the study of ultrathin cross sections of the right optic nerve with an electron microscope in animals treated group. Young elongated mitochondria with dense matrix and ordered christes were founded in axoplasma of MNF. The moderate amount of microtubule clearly structured and neyrofilamenty were indicated the recovery of backbone and conductivity of the neural fibers [9]. The large nucleus with dispersed chromatin and multiple clear nucleolemas shallow invagination of young mitochondria and clearly arranged tank granular endoplasmic reticulum were detected in the cytoplasm of neurolemocytes. Many ribosomes were situated on its surface. These morphological features are evidence of active electric utility and biosynthetic processes that occur in neyrolemocytes [10].

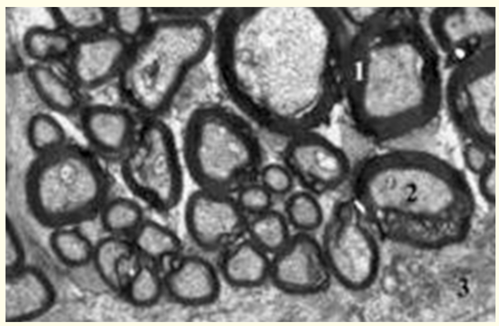

Figure 2: *The rabbit right optic nerve intracranial part with traumatic crush's restorative processes at 14th day after treatment. Inc.: 6400.*
Notes: *1 - MS, 2 - microtubules and neyrofilamenty of axoplasme in MNF, 3 - neurolemocites cytoplasm.*

But it were present MNF with widespread MS else. There lamellar structure of myelin was disorder. Different size vacuoles were found between the individual lamellas. MS had incorrect form (Figure 3). Such fibers observed shrinkage and increased axial cylinder in there peryaxonal space where electoral compact cells, myelin remains and multibubble structure were often detected. Single fibrous layers situated in the epi-, peri- and endonevral spaces. But there was much less as in untreated animals. Endoneural tissue was still swollen surrounds the vessel.

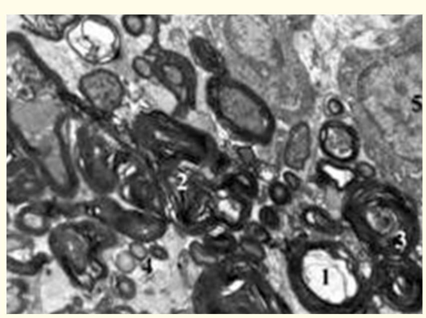

Figure 3: *The right intracranial optic nerve with traumatic crush of the rabbit destructive changes at 14th day after high doses cortecosteroides. Inc.: 6400.*
Notes: *1 - swelling of the axolema of nerve fiber, 2 - Strips bundle myelin, 3 - swelling of the myelin sheath, 4 - MNF of preserved ultra structure, 5 - core of neurolemocytes.*

Such changes morphological structure of the right optic nerve recovery occurred against the backdrop of blood. The endoneural tissue's capillaries were round shape with a rounded or oval lumen. The nuclei of the endothelial cells became elongated with marginally located chromatin (Figure 4). Cytoplasm was increased electron optical density (Figure 4a) and contained young mitochondria, single micropinocytal bubbles in some endothelial. There were young endothelial cells [11]. Other endothelial cytoplasm were moderate and low density of large and small vacuoles and plenty of micropinocytal bubbles, indicating the presence of edema processes in these cells [11]. Luminal plasmolema of endothelial surface had a different shape and depth of the protrusion. They were often segregated into the lumen of the capillary forming microclasmatos (Figure 4b) [12].

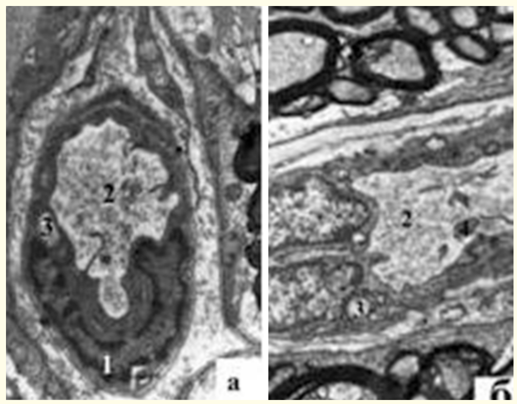

Figure 4: *The right intracranial optic nerve traumatic crush's hemodynamic restorations at the 14th day high doses cortecosteroides used. Inc.: 6400.*
Notes: *1 - endothelial nuclei elongated with marginally located chromatin,*
2 - capillary lumen, 3 - vacuoles in the cytoplasm of endothelial cells, 4 - microklasmatos.

Thus there were found microcirculation observed, a swelling decrease and remyelinisation of traumatic damaged intracranial part optic nerve's fibers at 14th day after the use of high doses of corticosteroids. MS is clearly ordered. There are young elongated mitochondria in its axoplasme, microtubules are formed and structured neurofilaments. All this indicates the recovery of backbone and conductivity. There are early manifestations of optic nerve regenerative [13].

However, disregarding the direct neuroprotective effect of high-dose corticosteroids, this method of treatment has a strong negative effect, due to its high toxicity and high mortality in animals up to 1 month of experimental animals in both groups. This cases it difficult to use high doses of corticosteroids in clinical settings and necessitates an alternative method for the treatment of traumatic optic neuropathy [14].

Conclusion

Consequently results showed reduce of microcirculation swelling and remiyelinisation of MNF that improves of activation of optic nerve crush regeneration by corticosteroids high doses at the 14th day. High toxicity necessitates an alternative method for the treatment of traumatic optic neuropathy.

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