THE EFFECT OF NERVE ISOLATION ON CERTAIN MUSCLE PROTEIN INDICES DURING APPLICATION AND AFTER REMOVAL OF A HEMOSTATIC TOURNIQUET

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In previous articles [1, 2] the writer has shown that after application of a hemostatic tourniquet, changes occur in the properties of the muscle proteins of the traumatized limb. Particularly severe changes in the nitrogenous components of the muscles are observed one month after removal of the tourniquet from the limb [2].

The principal cause of the disturbances associated with the presence of the tourniquet on the limb is interference with the trophic function of the nervous system as a result of trauma to the peripheral nerves. A significant role is also played by injury to blood vessels, anoxia, and disturbance of the nutrition of the tissues of the injured limb.

In an attempt to explain the role of the nervous factor in the development of the pathological reactions to the presence of a hemostatic tourniquet, we compressed a limb by a tourniquet but protected the main nerve trunk against mechanical injury.

EXPERIMENTAL METHOD

The experiments were conducted on a rabbit under light ether anesthesia. The skin was incised, the muscles separated by blunt dissection, and the sciatic nerve mobilized and placed in a special plexiglas cover, 3 cm long and 2 cm wide, with four holes at the ends. A silk thread was passed through these holes and brought out to the surface, where it served as a guide for application of the tourniquet. After the nerve had been placed in its cover, the wound was sutured and the tourniquet applied over the middle of the cover. The operation was usually carried out bloodlessly and it lasted 10-15 minutes.

If the tourniquet was removed from the rabbit so that the subsequent restitution could be studied, the cover was extracted without preliminary administration of an anesthetic, for the animals always remained quiet during this operation.

In the control group of animals, the tourniquet was applied without isolation of the nerve in the middle third of the right thigh. The tourniquet consisted of a rubber tube, 0.5 cm in diameter.

The myosin, water-soluble protein, and residual nitrogen concentrations were estimated by the methods described in the previous article [2].

EXPERIMENTAL RESULTS

The figures indicating how these muscle components changed after application and removal of the tourniquet and with or without isolation of the nerve are given in the table. The figures are the mean values of 5-10 experiments. The significance of the results was determined statistically.

It will be seen from the table that when the muscles were compressed for 3 hours the solubility of the myosin was lowered by an average of 15%. During compression and isolation of the nerve the solubility of the myosin in the muscles of the traumatized limb was practically unchanged.

One month after removal of the tourniquet, which was applied to the limb for 3 hours, the myosin level fell on the average by 19%, the water-soluble proteins by 20%, and the residual nitrogen by 15%. If the nerve was isolated,

Concentration of Proteins and Residual Nitrogen in the Muscles (in % of Dry Weight) After Application and Removal of a Hemostatic Tourniquet

Experimental conditions	Duration of recovery (in months)	Myosin			Water-soluble proteins			Residual nitrogen		
		intact muscle	below tourniquet	difference (%)	intact muscle	below tourniquet	difference (%)	intact muscle	below tourniquet	difference (%)
Compression for 3 hours										
Without isolation of the nerve	0	25.2	21.5	-15	18.2	19.2	+5	1.36	1.33	-2
With isolation of the nerve	0	19.2	18.6	-3	15.6	15.4	—	1.41	1.31	-7
Without isolation of the nerve	1	20.8	17.0	-19	15.9	12.7	-20	1.59	1.36	-15
With isolation of the nerve	1	17.8	15.3	-14	15.6	12.7	-19	1.25	1.04	-17
Compression for 6 hours										
Without isolation of the nerve	0	23.7	13.9	-42	19.3	19.0	—	1.12	1.19	+6
With isolation of the nerve	0	18.7	17.5	-6	15.3	14.3	-6	1.32	1.31	—
Without isolation of the nerve	1	19.5	15.1	-23	15.0	11.8	-22	1.26	1.07	-15
With isolation of the nerve	1	17.0	15.1	-12	16.4	12.9	-21	1.16	1.16	—

at the same time of restitution the changes in the nitrogenous components of the muscles were almost the same as without isolation. It is important to note, however, that when the limb was compressed in the usual way with the tourniquet the traumatized muscles preserved 77% of their weight, whereas when the nerve was isolated, the muscles below the tourniquet preserved 90% of their weight by comparison with the intact muscles.

When the limb was compressed for 6 hours by the tourniquet, the solubility of the myosin fell by 42% compared with the muscles of the intact limb. When the nerve was isolated, the solubility of the myosin after compression hardly differed from that of the intact muscles.

One month after removal of the tourniquet, which was applied to the limb for 6 hours, without isolation of the nerve, the myosin level fell sharply (by an average of 23%), and there was a considerable fall in the concentration of water-soluble proteins (by 22%) and residual nitrogen (by 15%). If the nerve was isolated during compression, after one month of restitution the myosin content of the muscles of the traumatized limb fell by an average of 12%, the level of the residual nitrogen remained unchanged, and the water-soluble proteins were diminished to the same extent as after compression of the muscles without isolation of the nerve.

At this time of restitution the weight of the muscles averaged 63% when the nerve was not isolated, and 85% when it was isolated, compared with intact muscles.

Consequently, if the sciatic nerve of the rabbit was isolated during compression of its limb by a tourniquet, the disturbances in the nitrogenous components of the muscles were less than after compression without isolation of the nerve.

We consider particularly important the fact that the muscles compressed with isolation of the nerve lost much less in weight in the period of restitution than when the nerve was not isolated. This loss of weight is known to occur chiefly on account of proteins. When the nerve was isolated, one month after removal of the tourniquet after remaining in situ for 6 hours, the muscles of the traumatized limb lost only 15% of their weight and preserved considerably reserves of myosin. Consequently, the muscle atrophy usually developing in the recovery period after removal of a tourniquet was less marked if the nerve was protected against mechanical injury.

It must be remembered, however, that if the nerve is isolated and placed in a cover for 3-6 hours, it does in fact suffer injury, so that the integrity of the neuromuscular interrelationships is disturbed. This naturally must influence the course of the biochemical processes in the tissues both during compression and after removal of the tourniquet.

Our experiments showed that even in these conditions protection of the peripheral nerve against injury during compression of a limb by a tourniquet is of great importance in maintaining the constancy of the protein composition and weight of the muscles, both during compression and in the recovery period.

LITERATURE CITED

1. A. A. Novikova, Arkh. Pat., (1960), No. 2, p. 46.
2. A. A. Novikova, Vopr. Med. Khimii, (1959), 5, No. 5, p. 333.

All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
