MORPHOLOGY OF THE POSTMORTEM CHANGES IN THE NERVOUS APPARATUS OF THE ARCH OF THE AORTA

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UDC 616.132.14-018.8-091.1

It is recommended that necropsy material from human cadavers and cadavers of experimental animals for use in neurohistological investigation be taken during the first few hours after death. Only if this condition is satisfied can a correct interpretation be made of the histological preparation, because postmortem changes develop comparatively quickly in nerve tissue as a result of autolytic processes [4-6]. In practice, necropsy material from human cadavers may be obtained 6-16 h after death. According to reports in the literature [1-3, 5, 7] these periods are perfectly adequate for the study of the extra- and intramural ganglia of the autonomic nervous system and also of the peripheral nerve trunks. However, it is not certain whether these times of postmortem examination are acceptable for the study of the receptor apparatuses of the internal organs and the cardiovascular system.

In this paper the results are described of an investigation undertaken to study the morphology of the postmortem changes in the nervous apparatus of the depressor zone of the arch of the aorta.

EXPERIMENTAL METHOD

Experiments were carried out on the cadavers of healthy, sexually mature animals of both sexes: 26 dogs and 15 cats. The dogs were mainly electrocuted and the cats killed with a lethal dose of ether on chloroform. The cadavers of the animals were kept at 16-18° and autopsied 1, 2, 3, 4, 5, 7, 10, 14, and 18 h after death. Starting from 7 h after death some of the cadaverswere kept at 1-3°.

Material was also studied from clinically healthy persons dying suddenly from accidental causes (mainly from traumatic injury), aged 19-59 years. Material for the investigation was taken 3-20 h after death. The precise length of time between death and examination was known in 14 of the 25 cadavers examined.

Fixation of the material and its subsequent treatment were carried out in accordance with the impregnation method of Bielschowsky-Gros and Kampos.

EXPERIMENTAL RESULTS

Analysis of the preparations were made from the arch of the aorta of the dogs and cats showed that the afferent apparatuses of the depressor zone of the arch of the aorta, formed by thick and medium-caliber medullated nerve fibers and their endings, in the form of compact "brushes," were the first to undergo postmortem changes. Within 3-4 h after death of the animals the medullary sheaths of the fibers swelled and, as a result of decomposition of the myelin, began to resemble spotted bands, within which the hyperimpregnated nuclei of the Schwann cells and the axons could be seen. These axons first became vacuolated, then disintegrated, and part of their axoplasm was subsequently destroyed (Fig. 1, a).

Fragmentation of the myelin sheath with the formation of myelin ovoids began 5-7 h after death. The axons also disintegrated, and fragments of them appeared to be enclosed in the ovoids (Fig. 1, b). Isolated segments of the axons sometimes preserved their continuity for sometime after the surrounding myelin sheath had become totally destroyed.

After storage of the cadavers of the animals for 10-14 h, massive disintegration was observed not only of the aortic baroceptor fibers of large and medium caliber, but also the afferent nerve fibers of small caliber, most resistant to postmortem changes, and also thin fibers of autonomic origin.

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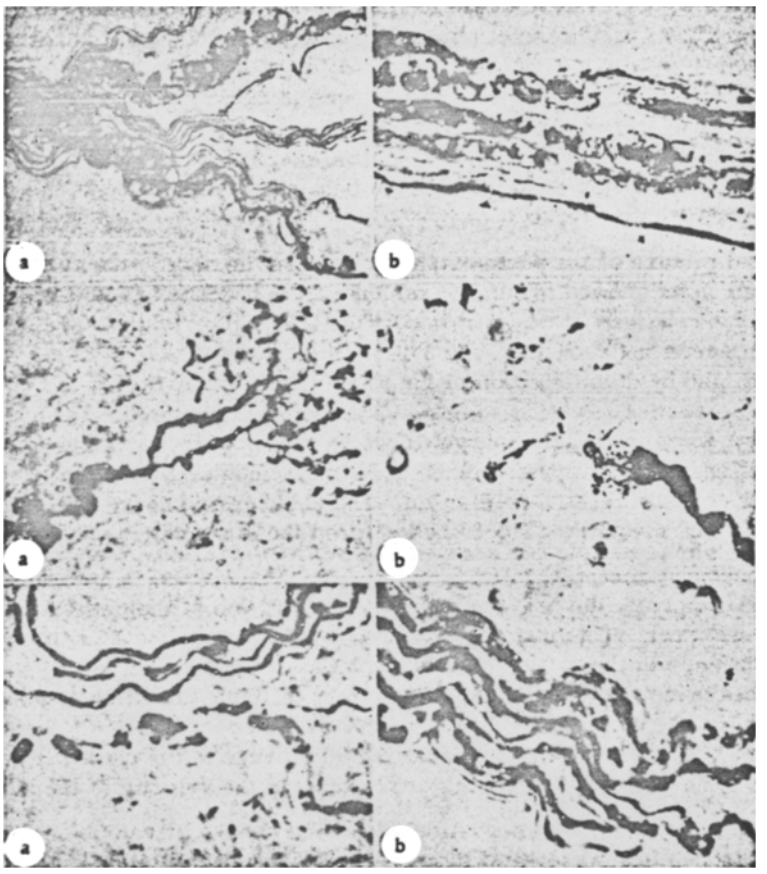

Fig. 1. Depressor zone of the arch of the aorta in a dog 3 h (a) and 7 h (b) after death. Various stages of postmortem degeneration of the thick medullated nerve fibers can be seen. Photomicrograph. Kampos. Magnification 400×.

Fig. 2. Depressor zone of the arch of the aorta in a dog 2 h (a) and 5 h (b) after death. Explanation in text. Photomicrograph. Kampos. Magnification 400×.

Fig. 3. Depressor zone of the arch of a human aorta 4 h (a) and 10 h (b) after death. Explanation in text. Photomicrograph. Kampos. Magnification 400×.

The postmortem changes in the terminal portions of the aortic baroceptors, especially the endings of compact "brush" types, must be examined particularly closely. Whereas during the first 2-3 h after death these nerve structures in most cases showed an increased affinity for silver salts, so that they could be clearly seen as far as their most terminal branches (Fig. 2, a), later they appreciably lost their argyrophilic properties. Many of the baroceptor apparatuses of the animals 4-5 h after death were stained extremely unsatisfactorily, giving the impression of "unsuccessful" impregnation (Fig. 2, b). Careful analysis of the preparations by means of immersion systems and the phase-contrast microscope showed that the structure of the terminal portion of the baroceptors in necropsy material taken at these times was still preserved. However, soon after they entered a stage of total anargyrophilia, preventing further observations on their postmortem changes. For instance, 7-10 h after death of the animals in most cases the brush-like endings could no longer be seen. Their position could be judged only from the severely fragmented preterminal portions of the baroceptor fibers.

The above description applies to the morphology of the postmortem changes in the nervous apparatus of the depressor zone of the arch of the aorta in dogs and cats whose cadavers were kept in ordinary

conditions in an external air temperature of 16-18°. When, however, the cadavers of the animals were kept in the cold (about 1-3°), as a rule the degenerative changes in the aortic baroceptors were less severe. The relationship between the postmortem changes and the temperature was seen especially clearly when autopsy was performed late—10-14 h after death. Whereas in cadavers stored in ordinary conditions these signs coincided with the final stages of necrosis in the nervous apparatus of the arch of the aorta, in cadavers kept for the same length of time in the cold the degeneration of the nervous structures was less pronounced. The temperature factor (other conditions being equal) thus affects the intensity of the necrotic changes taking place in the aortic baroceptors.

The morphological picture of the postmortem changes in the nerve structures in the depressor zone of the arch of the human aorta showed much in common with that described above. As in the laboratory animals investigated, obvious signs of degeneration of the baroceptor fibers were observed in the nervous apparatus of the human aortic reflexogenic zone 3-5 h after death. The first signs were edema of the myelin sheath accompanied by disintegration of the myelin and vacuolation of the swollen axons. These changed their staining properties, showing sometimes a greatly increased and at other times a decreased affinity for silver salts. Some medullated nerve fibers in necropsy material obtained at these times were in a state of fragmentation. In cadavers examined at later periods after death, the signs of postmortem degeneration of the baroceptors were more marked. The degenerated nerve structures were more numerous. Fragments of thick medullated fibers had entered the stage of granular degeneration (Fig. 3, a, b).

Meanwhile, the necropsy material taken from the human cadavers, in contrast to that obtained from the cadavers of the dogs and cats, did not show rapid disintegration of the nervous apparatuses of the depressor zone of the aortic arch. This difference was evidently caused by the slower course of the necrobiotic and necrotic processes in the corresponding nerve structures in the human cadavers by comparison with those of the animals investigated. However, it is very difficult to estimate the rate of development of degenerative changes on the basis of investigation of necropsy material from human cadavers, because it is often impossible to take into account the conditions of storage of the cadavers (the temperature and humidity of the air) and other factors increasing or decreasing the velocity of the autolytic processes.

To summarize the results of the observations described above, it can be concluded that postmortem changes in the aortic baroceptors discovered in necropsy material of clinically healthy persons and normal (control) laboratory animals have much in common with the pathomorphological changes in these same nervous apparatuses repeatedly described in diseases and in experimental conditions. This demonstrates the need for care in differentiating between pathological changes developing during life in the nervous structures and changes which may take place in them under the influence of postmortem autolytic processes. Otherwise, postmortem changes may give rise to mistakes in the interpretation of the factual material and to ungrounded conclusions.

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