Ultrastructure of hepatic cells in rabbits after injection of nanoparticles MCS-B

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ABSTRACT

In order to determine ultrastructural reconstructions in hepatic cells under effect of magnetite, an experiment was conducted on 45 rabbits. They received a single intravenous injection of nanoparticles MCS-B at a dosage of 75 mg/kg of body weight 24 hours before the investigation.

Ultrastructural changes in hepatocyte organelles manifested pronounced signs of activation of reparative intracellular processes.

Hepatocyte nuclei held their rounded shape. Nuclear membranes had well-defined contours. Chromatin, in the form of small clods, was evenly distributed throughout the section. Condensation of chromatin on the nuclear membrane was observed only in single hepatocytes. Perinuclear space was not enlarged. Single ribosomes were found on the outer membrane of the nucleus.

Mitochondria were evenly distributed in all parts of the cytoplasm of the hepatic cells. Mitochondrial matrix had a moderate electron density and a fine grane structure. Shape of the mitochondria varied from rounded to stick-like. Many cristae were revealed; they had a pronounced typical orientation. The outer membrane remained integral, without any foci of destruction. In single cells, there were mitochondria having the shape of dumb-bells and with septa. The rough endoplasmic reticulum underwent the most characteristic reconstructions. In the majority of hepatocytes, their rough endoplasmic reticulum was an extensive network of membranes with numerous ribosomes localized on their surfaces. Cisterns of the endoplasmic reticulum were slightly enlarged and their shape resembled flattened vesicles. The substance which filled them was electron transparent. The smooth endoplasmic reticulum was well developed, its vacuoles were mostly localized in basal parts of the cytoplasm. It should be noted that there were great numbers of free ribosomes and granules of glycogen which were evenly distributed throughout the cytoplasm. The laminated cytoplasmic Golgi's complex was moderately hypertrophic, its membrane part consisted of parallel smooth membranes. Packs of these membranes were surrounded with a great number of large and small vesicles. Single vesicles were filled with a rough fibrous osmiophil substance. There was rather a great number of primary lysosomes in the area of localization of the laminar cytoplasmic Golgi's complex, autophagosomes and small inclusions of lipids being observed in single cells. Bile capillaries were filled with prolonged crimped microvilli and were moderately dilated.

Sinus capillaries and Disse's spaces were dilated rather extensively. Disse's spaces were filled with numerous microvilli. Changes in the ultrastructure of Kupffer cells testified about their functional activity. Nuclei of Kupffer cells were of irregular shape with deep invaginations of the nuclear membrane. Nuclear matrix had a significant electron density. Karyolemma had no destructive changes.

The cytoplasm of Kupffer cells revealed single and slightly swollen mitochondria which contained a small number of cristae and single cisterns of the rough endoplasmic reticulum. The cytoplasmic membrane did not undergo any changes and held its well-defined bilaminated structure. It should be noted that there was a great number of small electron-transparent micropinocytic vesicles.

***Keywords*:** ultrastucture, hepatic cells, nanoparticles MCS-B, activation, reparative.

MATERIAL, METHODS OF RESEARCH

In order to determine ultrastructural reconstructions in hepatic cells under effect of magnetite, an experiment was conducted on 45 rabbits. They received a single intravenous injection of nanoparticles MCS-B at a dosage of 75 mg/kg of body weight 24 hours before the investigation.

Organs of intact animals were used as controls. After completion of the experiment the animals were killed and the above organs were taken for electron microscopic examinations.

Necessary areas of sections were photographed on photographic plates which served for subsequent taking of microphotographs.

RESULT OF RESEARCHES

Ultrastructural changes in hepatocyte organelles manifested pronounced signs of activation of reparative intracellular processes.

Hepatocyte nuclei held their rounded shape (Figure 12). Nuclear membranes had well-defined contours. Chromatin, in the form of small clods, was evenly distributed throughout the section. Condensation of chromatin on the nuclear membrane was observed only in single hepatocytes.

Perinuclear space was not enlarged. Single ribosomes were found on the outer membrane of the nucleus.

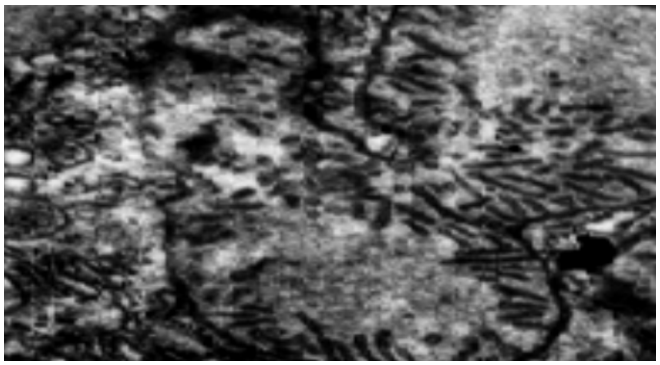

Fig. 12. Ultrastructure of hepatocytes in rabbits after injection of nanoparticles MCS-B x 39.000

Mitochondria were evenly distributed in all parts of the cytoplasm of the hepatic cells (Figure 13).

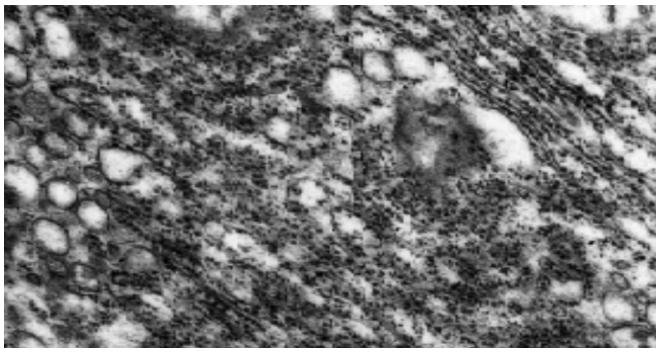

Fig. 13. Ultrastructure of hepatocytes in rabbits after injection of nanoparticles MCS-B x 30.000

Mitochondrial matrix had a moderate electron density and a fine grane structure. Shape of the mitochondria varied from rounded to stick-like. Many cristae were revealed; they had a pronounced typical orientation. The outer membrane remained integral, without any foci of destruction. In single cells, there were mitochondria having the shape of dumb-bells and with septa. The rough endoplasmic reticulum underwent the most characteristic reconstructions (Figure 14).

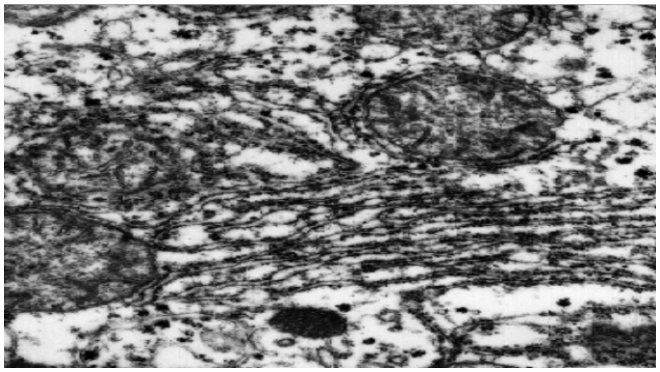

Fig. 14. Ultrastructure of hepatocytes in rabbits after injection of nanoparticles MCS-B x 42.000

In the majority of hepatocytes, their rough endoplasmic reticulum was an extensive network of membranes with numerous ribosomes localized on their surfaces. Cisterns of the endoplasmic reticulum were slightly enlarged and their shape resembled flattened vesicles. The substance which filled them was electron transparent. The smooth endoplasmic reticulum was well developed, its vacuoles were mostly localized in basal parts of the cytoplasm. It should be noted that there were great numbers of free ribosomes and granules of glycogen which were evenly distributed throughout the cytoplasm. The laminated cytoplasmic Golgi's complex (Figure 15) was moderately hypertrophic, its membrane part consisted of parallel smooth membranes.

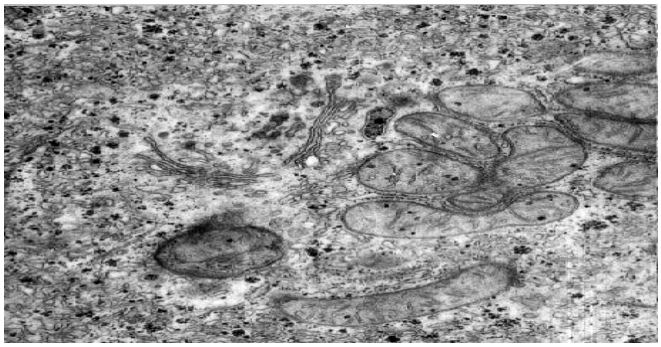

Fig. 15. Ultrastructure of hepatocytes in rabbits after injection of nanoparticles MCS-B x 40.000

Packs of these membranes were surrounded with a great number of large and small vesicles. Single vesicles were filled with a rough fibrous osmiophil substance. There was rather a great number of primary lysosomes in the area of localization of the laminar cytoplasmic Golgi's complex, autophagosomes and small inclusions of lipids being observed in single cells. Bile capillaries were filled with prolonged crimped microvilli and were moderately dilated.

Sinus capillaries and Disse's spaces were dilated rather extensively. Disse's spaces were filled with numerous microvilli. Changes in the ultrastructure of Kupffer cells testified about their functional activity. Nuclei (Figure 16) of Kupffer cells were of irregular shape with deep invaginations of the nuclear membrane.

Fig. 16. Ultrastructure of hepatocytes in rabbits after injection of nanoparticles MCS-B x 39.000

Nuclear matrix had a significant electron density. Karyolemma had no destructive changes.

The cytoplasm of Kupffer cells revealed single and slightly swollen mitochondria which contained a small number of cristae and single cisterns of the rough endoplasmic reticulum. The cytoplasmic membrane did not undergo any changes and held its well-defined bilaminated structure. It should be noted that there was a great number of small electron-transparent micropinocytic vesicles.

CONCLUSION

Analysis of the state of submicroscopic architectonics of hepatic cells in rabbits after injection of nanoparticles MCS-B reveals a significant activation of metabolic intracellular processes in liver. Ultrastructural organization of the liver testifies about intensification of synthetic intracellular processes, it being structurally manifested by enlargement of cisterns in the rough endoplasmic reticulum, an increased number of ribosomes and a moderate hypertrophy of the laminar cytoplasmic Goldi's complex. Activation of reparative intracellular processes is another aspect of these reconstructions. It is confirmed by a revealed hyperplasia of the rough endoplasmic reticulum, this hyperplasia testifying about intensive processes of self-renewal in submicroscopic structures. Presence of mitochondria having the shape of dumb-bells and with constrictions in the cytoplasm of hepatic cells enables a statement that a process of an intensive increase in the number of these organelles tares place.