Studies on Histological, Cytological and Cytochemical Changes in the Liver of Rabbits Caused by the Alteration of Atmospheric Temperature

II. The changes of polysaccharide at 26—28°C

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Atmospheric temperature, body temperature, water content of blood and liver function are all in intimate correlation between each other as Ono referred in the foregoing paper (Ono, 1953). Among these works, however, most of them are belonging to the studies on the influence of low atmospheric temperature upon metabolism, and that of high atmospheric temperature has been as yet less approached. Abe (1951) maintained that the heat generation in liver diminishes in an environment of a high atmospheric temperature. In this paper the author reports on polysaccharide in liver cells of the rabbit, when the animal is warmed within a range where the treatment is not enough to raise the body temperature.

Material and Method

The material and the experimental method are just the same as those experienced in the foregoing study (Ono, 1953). A piece of tissue was taken from the liver just after the experiment and instantly fixed with 70% alcohol, dehydrated, imbedded into paraffin, sectioned 4 μ thick, stained with periodic acid-Schiff method (Hotchkiss, 1948) and counterstained with Heidenhain’s iron hematoxylin.

For the determination of the existence of glycogen the digestion test was carried out in 1% diastase solution at 37°C for 24 hours.

Observations

Control cases:—The most intense stainability is seen on the central region of the lobule, the intermediate zone of lobule is stained
moderately and the peripheral region has the weakest coloration. It may be said that the substance shows a central distribution. In the hepatic cells in the central region of a lobule, as shown in Fig. 1, polysaccharide stands out as filaments or as rods in cytoplasm, and is not visible in nucleus. Polysaccharide in the intermediate and in the peripheral region of a lobule takes the same type of shape, but is quantitatively scarce, and often lacks in some cells.

Cases of experiments:—The intensity of the stainability is almost equal in the center, in the intermediate and in the peripheral region of a lobule. It distributes diffusely or homogeneously. Polysaccharide, as shown in Fig. 4, 5 and 6, is present in cytoplasm as comparatively distinctly outlined granules and rods, and extreme fine filaments between these granules and rods.

When digested in 1% diastase solution at 37°C for 24 hours, the reddish or purple coloration disappeared. Therefore the foredescribed reddish or purple colored substance probably consists mostly of glycogen.

Discussion

According to Rosenberg (1910) the so-called "glycogen", which is stained by Best's carmin, shows a diffuse and a central distribution with a same frequency in a lobule of rabbit liver.

Klestadt (1912) asserted the central distribution of the substance within a lobule of a fasted animal's liver.

The centrolobular distribution of polysaccharide in my control case may be the result of fasting for 24 hours.

Hida (1946) measured blood sugar, keeping fasted rabbits at 40°C (relative humidity 70%). From five to thirty minutes the value of blood sugar rises slowly, and from thirty to fourty five minutes it increases rapidly, followed by gradual slow rising up to sixty minutes. Glycogen distributes diffusely within a lobule of the liver. Hepatic cells are full of glycogen, looking consequently swollen. After further heating for from 110-285 minutes glycogen retains nearly the same mode of the diffuse distribution in a lobule as in the short duration of heating for 5-60 minutes. In 230-515 minutes, the longer the duration of the heating, the more distinct is the decrease of the glycogen content, and the type of its distribution tends more to the center.

Hino (1926) found that glycogen distributes localize only in the
central region of liver lobules in rabbits after a starvation for three days. On the other hand he measured quantitatively the glycogen content of whole liver, and made it clear that the rise and drop of the analytical value fluctuate exactly in parallel with the histological increase and decrease of glycogen.

Comparing the centrolobular distribution of polysaccharide in my control cases and the diffuse distribution within liver lobules in my experiment cases, it can be suggested that glycogen increases in liver as a result of heat treatment.

Conclusion

1. Polysaccharide of hepatic cells was observed cytologically in the rabbits, which were heated within a range where no rise of body temperature occurred.
2. In the control cases, polysaccharide distributes homogeneously and diffusely even in the peripheral region of a lobule, and takes the shape of filaments or rods.
3. In the experiment cases, glycogen is seen as comparatively well defined granules or rods and as extremely thin threads between the former.
4. The shape and the distribution of glycogen change as a result of heat treatment.

References

Explanation of figures

Fig. 1-3. The control cases. The nucleus and the nucleolus are stained only with Heidenhain's iron hematoxylin. Polysaccharides are shown as threads or rods, and filamentous bodies which are stained only with hematoxylin, are observed in the cytoplasm.
- Fig. 1. The centre of the lobule.
- Fig. 2. The intermediate zone of the lobule.
- Fig. 3. The periphery of the lobule. There are two kinds of cells, the first does not include polysaccharides and the second includes very small amounts of polysaccharides.

Fig. 4 6. The experimental cases. The nucleus and the nucleolus are stained only with Heidenhain's iron hematoxylin. Polysaccharides are observed as distinctly outlined granules or rods, and fine threads which exist between them, and filamentous bodies which are stained with hematoxylin, are observed in the cytoplasm.
- Fig. 4. The centre of the lobule.
- Fig. 5. The intermediate zone of the lobule.
- Fig. 6. The periphery of the lobule.
  Stained with PAS method and Heidenhain's iron hematoxylin. magnification ca. 700×