Pathological Changes in the Retina of Hypertensive Rats. Shigeki Takahashi, Yasuna Hamai, and Sanai Sato. Department of Ophthalmology, Yamagata University School of Medicine, Yamagata-shi 990-23

The authors have previously reported on the histological findings of the retina, the retinal vessels, the optic nerve and the other ocular tissues in SHRSPs.

In this study, we compared the histological findings of the hypertensive papilledema in both the Stroke Prone Spontaneously Hypertensive Rat (SHRSP) and the Renal Hypertensive Rat (RHR).

The experimental animals which were used were 4 SHRSPs. The ages of the 4 SHRSPs ranged from 6 months old through 10 months old. The 3-month-old and 6 through 7-month-old WKYs were used as RHRs and they all underwent an operation (two clip two kidney) to elevate their blood pressure.

Their blood pressure was measured and their fundi were examined by ophthalmoscope once every week. The fundus photography was constantly taken with a fundus camera.

To observe the histological changes of the ocular tissues, the animals were killed and the eyes with optic nerves attached were enucleated. The eyes were cut in small pieces, and were double fixed in a 2% glutaraldehyde and 1% OsO₄ solution. Then, they were dehydrated in graded series of ethylalcohol and embedded in Epon.

The epon-embedded tissues were then cut on a ultramicrotome. The ultra thin sections were stained with uranyl acetate and lead citrate, and examined with an electron microscope.

Elevation of the blood pressure of the SHRSPs was recognized 4 to 6 weeks after birth. By 10 weeks after birth, their blood pressure had reached 230-260 mmHg in all cases.

In the funduscopic examination, narrowing and caliber irregularities of the retinal arterioles were correlated to an elevation of blood pressure. These changes were the same as those of the SHRSPs.

Hypertensive papilledema was observed in 3 of the 4 3-month-old animals and in 2 of the 4 animals in the 6 through 7-month-old RHR group.

In electron microscopic findings, the vacuolation of the retina in SHRSPs was observed whether or not there was any papilledema. And, it was mainly observed in the inner retinal layer. Hypertrophy of axon, degeneration of micro-organelles in the axon and the so called cytoid body were observed in the nerve fiber layer of the retina in SHRSPs which had papilledema. Moreover, the degenerated layer of the retina was replaced with Müller cells. On other hand, the retinal changes of the RHRs were the same as those of the SHRSPs, i.e., vacuolation of the retina was recognized whether or not there was any papilledema. Hypertrophy of the axon and degeneration of the micro-organelles in the axon were also recognized in the RHRs. The finding of retinal arterioles was generally recognized as the vacuolation of the retinal endothelium in both the SHRSPs and the RHRs.

It was revealed that the narrowing and the caliber irregularity of the retinal arterioles were related to long term hypertension. Therefore, these histological findings seem to suggest that disturbance of the blood stream is related to ischemia of the retina.

As mentioned above, the retinal changes during hypertension were related to retinal ischemia which was caused by the narrowing of the retinal arterioles rather than the elevation of blood pressure.

So, the findings were chiefly observed in the inner layer of the retina.