QUANTITATIVE STUDY OF GLIOSIS IN DEGENERATING PYRAMIDAL TRACTS*

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The term “gliosis” is very commonly used in neuropathological parlance, and is applied most often to indicate an increase of glia cells in degenerating white or gray matter. The mechanism by which this increase develops is not known, and two theories exist to explain it. According to the first, there is an actual increase of cells due to their multiplication; according to the second, the increase is only apparent, being caused by the shrinkage of the tissue.

Lassek and Shapiro (1) compared the number of nuclei in the pyramidal tract of the cat in various stages of degeneration and suggested that gliosis “may be largely an illusion caused by shrinkage of affected tissue with crowding of glia cells.” The pyramidal tract at the level of the medulla is particularly suitable for this type of analysis. In other regions, the three dimensional shrinkage and distortion, as well as the difficulty in precise delineation of the degenerated structure, makes the comparison of the volume between the normal and degenerated region very difficult. Here the pyramids lie side by side, can be easily delineated and shrink in two directions only, so that the comparison of their surfaces on cross section gives a direct and accurate indication of changes in volume.

We had two opportunities to study gliosis quantitatively in the pyramidal tract. The first was that of a man who had an infarct in the internal capsule 7 years before death. The pyramid on the degenerating side was almost completely demyelinated and smaller. We made a low power photomicrograph of a cross section of the medulla, cut out from the photographic paper the normal and degenerated pyramids and compared the weight of the two pieces of paper. Their ratio was 3.3 to 1, that is to say, the surface—or volume—of the normal pyramid was 3.3 times greater than that of the degenerated one. Then we took several high power photomicrographs at the same magnification of a Nissl stained section, choosing at random various regions of the normal and degenerated pyramids. We counted all nuclei on these photomicrographs, with the exception of those belonging to the blood vessels. The ratio of the number of nuclei per arbitrarily chosen, but equal volume, of the degenerated to normal pyramid was 2.4 to 1 (fig. 1A). Thus, we found that the shrinkage is even greater than the increase in cells density, which must indicate that a proportion of cells had disappeared from the degenerated pyramid.

The second opportunity was that of a man who had an infarct in one side of

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the pons 10 years before death. It produced partial demyelination and shrinkage of the pyramid on the corresponding side. The volume of the pyramids and the density of glial nuclei were compared, using the same method described for the first case. In this case, the volume of the normal pyramid was 2.07 times greater than that of the degenerated one, while the cell density on the degenerated side was only 1.1 times greater than on the normal side (fig. 1B). Thus, we found again that the shrinkage was greater than the increase in cellularity.

The next step in the study of this problem would be to investigate the type of cells which participate in causing gliosis. It is quite possible, for instance, that
one type of cell may decrease in number, whereas another may show an absolute increase. Unfortunately, the specific staining methods for various glia cells are unreliable and we could not obtain adequate results on our material. The cells as seen on Nissl and Hematoxylin and Eosin stained sections, were not characteristic for any specific glia type; in particular neither compound granular corpuscles nor gemistocytic astrocytes were seen.

**SUMMARY**

In summary our results lend support to the theory that "gliosis" in degenerating pyramidal tracts is only relative and is due to the shrinkage of the tissue. An analysis of individual types of glia cells participating in this type of gliosis was not made due to technical difficulties. Such analysis should be a further step in the investigation of this problem.

**REFERENCE**