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gross anatomical picture of the brains correlated with the degree of difficulty the kittens had.

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## Histological and Gross Studies of Brain Tissue of Kittens Exhibiting Spastic Behavior

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*Abstract:* Histological and gross studies of brain tissue revealed lowered brain weight, lower brain weight to body weight ratios, and poor brain development in relation to the degree of spasticity exhibited in kittens but did not reveal any definite histological changes.

Examination of five spastic<sup>4</sup> kittens from the same litter and one normal kitten of approximately the same age from another litter had revealed abnormalities of the spastic animals in general behavior, reflex tests, and electroencephalograms (Drexler *et al.*, 1966; Cook and Collier, 1966). At the conclusion of these observations it was decided to sacrifice the animals so as to observe the extent of gross and histological changes within the brains, if any.

#### METHODS

After the completion of the behavioral observations on the animals, they were sacrificed by ether inhalation and weighed. Brains were then removed and weighed, and the sex of the kittens was ascertained. Brain weight per 100 grams of body weight ratios were calculated.

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<sup>4</sup> Spastic is defined here in a general sense denoting uncoordinated and at times jerky behavior.

Each individual brain was given an identifying number, placed in buffered formalin, and packaged in a nonbreakable plastic bottle for shipment to a tissue laboratory. There each brain was photographed, processed by a tissue processing machine, embedded, cut on a microtome at 5-6 microns, and divided into three groups of six slides each. One set was stained by the Hematoxlyn and Eosin method and the other two sets were not stained. After a preliminary reading of each slide, however, a calcium stain was done on all six brain sections because it was believed that one of the animals showed calcium deposits within the brain. Unfortunately, this special stain did not work so the presence of calcium was not confirmed by use of this stain. However, the presence of calcium was later seen in one animal by other means.

RESULTS

Body weights, brain weight to 100 grams body weight ratios, and descriptions of the brains are contained in Table 1. The spastic animals are numbered 1 through 5, in accord with the degree of behavioral difficulty they had, with 1 having the least difficulty and 5 the most. The control animal, 6, is at the top of the table.

Table 1. A Comparison of Body Weight, Brain Weight, and Brain Weight to Body Weight Ratios.

Animal	Sex	Body Weight (Gms.)	Brain Weight (Gms.)	Brain Weight to Body Weight Ratios	Comments
Control:					
Kitten #6	M	780.8	24.0	0.0307	Normal
Spastics:					
Kitten #1	M	851.0	23.1	0.0271	Normal
Kitten #2	F	805.2	23.3	0.0289	Normal
Kitten #3	M	741.7	19.9	0.0268	Cerebellum underdeveloped
Kitten #4	F	565.9	14.1	0.0249	Fewer convolutions in left occipital lobe; Underdeveloped cerebellum
Kitten #5	F	604.5	13.7	0.0227	Thinned cerebral hemispheres; Non-existent cerebellum

As noted, the most spastic animals had the lowest brain weight to body weight ratios. Indeed, the animals would have been arranged in the numerical order determined by their behavioral difficulties except that kitten number 2 had a higher brain weight to body weight ratio that did kitten number 1. Looking at animals 4 and 5, it can be seen that these animals had not only the lowest brain weights but also the lowest body weights. The lower body weights were not unexpected because these two animals were so spastic that they could not eat unaided.

At autopsy, the brains from kittens number 1 and 2 appeared normal as well as the one from the control animal. The cerebellum of animal 3 was underdeveloped. In kitten number 4, it was seen that the left occipital lobe had a fewer number of convolutions than did the right lobe. Its cerebellum was also underdeveloped. The most striking gross change was noted in the brain of kitten number 5; it had very few convolutions. In fact, because of thin cerebral hemispheres (averaging approximately 2mm. in thickness) the brain resembled an inflated balloon. The cerebellum was practically non-existent.

Examination of the microscopic slides showed abnormalities in only two of the six animals. Kitten number 2 showed satellitosis while kitten number 5 showed a deposit of calcium on one of the sections.

#### DISCUSSION

The most spastic animals, kittens number 4 and 5, had a lower body weight and a lower brain weight than did their siblings. Since the brain weight to body weight ratios are also lower in these animals, it is obvious that the lower brain weights are an indication of severe brain damage.

On the basis of gross examination, animals number 4 and 5 again stand out as being abnormal. The underdeveloped cerebellum in kitten number 4 and the almost nonexistent cerebellum (as well as the thin layer of cerebral hemisphere material) in kitten number 5 explains the lower brain weight. This is probably an important factor in the lack of coordination in these animals. According to Gardner (1958) in humans, cerebellar defects are generally manifested as disorders in timing or coordination. This may involve jerky movements, intention tremors, stumbling gaits, difficulty in standing, or limp or actually flacid muscles. Gardner also says that cerebellar signs are compensated for rapidly, provided that the lesion does not progress in size. It was noted in a previous study (Cook and Collier, 1966) that the two most uncoordinated animals did improve with time.

Kitten number 3, while not as abnormal as kittens number 4 and 5, still presented an underdeveloped cerebellum at autopsy. Behavioral observations showed that he was spastic and his electroencephalograms verified some degree of brain damage (Cook and Collier, 1966).

The importance of satellitosis in kitten number 2 and calcium deposits in kitten number 5 cannot be ascertained. However, satellitosis must not have affected the animal too greatly since its brain appeared typical at autopsy and its electroencephalograms were judged to be almost normal. In kitten number 5, the effect of calcium must have been rather minimal since a large

portion of its spasticity, and abnormal electroencephalograms, can be accounted for by its small, underdeveloped brain.

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