Structure Of The Dentate Nucleus In Some Mammals

Thesis

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By

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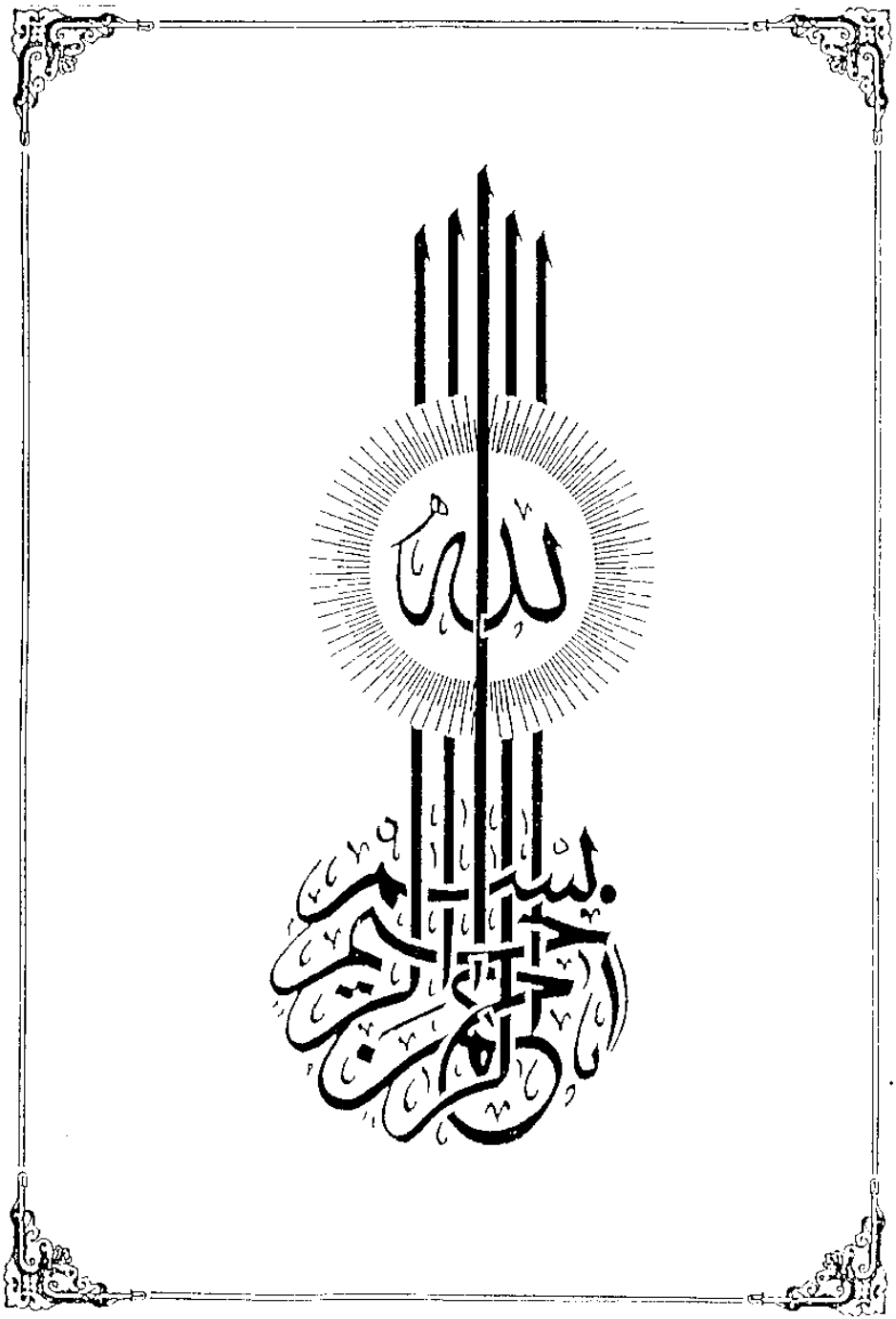

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CHAPTER I

INTRODUCTION

Though extensive studies were done on the mammalian cerebellum, yet the detailed structure of the dentate nucleus in different mammals required more investigations.

This study is a more or less complete investigation on the classification, nomenclature , morphology and histology of the nucleus dentatus in human beings, adult albino rats, cats and dogs.

In this work, a trial was also made to compare the structure of the nucleus in the different mammals and to discuss our results with those described by previous authors.

A correlation was made between the structure of the dentate nucleus and that of the olivary nucleus.

An explanation for the histological structure of the nucleus was searched for in relation to its physiological function.

REVIEW OF LITERATURE

CHAPTER II

REVIEW OF LITERATURE

I. Subdivision and nomenclature of the cerebellar nuclei.

Probably the first author who gave a detailed description of the central grey matter of the cerebellum was Stilling (1864). He described four nuclei in the human cerebellum, the most medial one was the nucleus fastigii, the most lateral was the nucleus dentatus, and the two nuclei inbetween were nucleus globosus and nucleus emboliformis from medial to lateral respectively.

Weidenreich (1899) reported that the cerebellar nuclei in mammals were four : nucleus medius, nucleus lateralis anterior, nucleus lateralis posterior, and nucleus lateralis. The nucleus medius was believed to correspond to the human nucleus fastigii, while the nucleus lateralis was believed to correspond to the nucleus dentatus. The other two nuclear masses were believed to correspond to the nucleus globosus and nucleus emboliformis.

Hatschek (1907) mentioned that the nucleus lateralis anterior and the nucleus lateralis posterior of Weidenreich were small in size in man and anthropoid apes, while the nucleus lateralis was enlarged to form the dentate nucleus.

Brunner (1919) in a wide comparative study, combined the nuclei lateralis anterior and posterior of lower mammals into one mass which was termed the nucleus interpositus. He considered any further subdivision of the nuclear masses apart from his classification i.e nucleus lateralis, medialis, and interpositus as unjustifiable. He also considered the term nucleus dentatus inappropriate for the lateral nucleus of subanthropoids because its surface was not dentated. In monotremes he described only two nuclei, the medial one was considered as the homologue of the nucleus fastigii while the lateral one was homologous with the nuclei interpositus and lateralis.

Sachs and Fincher (1927) studied the cerebellar nuclei in the monkey, and used the terminology of Stilling (1864). They described four nuclei in the cerebellum of the monkey.

Mussen (1927) considered the subdivision of the cerebellar nuclei in the monkey and cat into four as not reasonable, for he found that the two medial nuclei were fused together and the two lateral ones were practically inseperable.

Jansen and Brodal (1940) adopted the terminology of Brunner (1919) to the cerebellar nuclei of the rabbit and cat.

Snider (1940) described four nuclei in the cerebellum of the rabbit and cat. These were the nucleus medialis, the nucleus lateralis, the nucleus interpositus anterior, and the nucleus interpositus posterior.

Ranson (1943) described four nuclei in the human cerebellum. These nuclei were corresponding to the four nuclei previously described by Stilling (1864).

Dotty (1946) studied the cerebellum of the sparrow and stated that, the nuclear components of the cerebellum of that bird formed a single mass on either side of its midline.

Hassler (1950) classified the human cerebellar nuclei into four, and adopted the terminology of Stilling (1864) to them.

Rand (1954) studied the cerebellum of monkey and subdivided its nuclear components into three parts which were the nucleus fastigii, nucleus interpositus and nucleus lateralis or dentatus.

Jansen and Jansen, Jr. (1955) studied the cerebellar nuclei of young kittens and stated that they were subdivided into three parts which were similar to those described by Brunner (1919), however those parts were really fused together so that separation between them was arbitrary.

Jansen and Brodal (1958) adopted the nomenclature given by Stilling (1864) to the four subdivisions described by them in the human cerebellar nuclei.

Truex (1959) gave the same classification and nomenclature as those given by Jansen et al. (1958),to the human cerebellar nuclei.

Goodman, Hallett and Welch (1960) studied the cerebellum of albino rat and described three nuclear masses in it. Those were the nucleus dentatus, the nucleus interpositus, and the nucleus fastigii from lateral to medial respectively.

Flood and Jansen (1961) stated that the cerebellar nuclei in the adult cat were four groups: nucleus medialis, nucleus interpositus anterior, nucleus interpositus posterior, and nucleus lateralis.

Goodman, Hallett and Welch (1963) in a restudy on the cerebellar nuclei in albino rats, postulated that the separation between the dentate and interposed nuclei was rather arbitrary.

Zeman and Innes (1963) stated that the deep grey matter of the cerebellum in lower mammals was represented by a single mass located in the midline of the roof of the fourth ventricle. In higher mammals further nuclear masses became differentiated which from medial to lateral were: nucleus fastigii, nucleus interpositus and nucleus dentatus. In species above

the anthropoid apes the nucleus interpositus was differentiated furthermore into nucleus globosus and nucleus emboliformis.

Courville and Brodal (1966) in agreement with the classification given by Flood et al. (1961), described four nuclear masses in the cerebellum of the cat.

Treff (1974) described four nuclei in the human cerebellum, these were the dentate nucleus, the emboliform nucleus, the globose nucleus, and the fastigial nucleus from lateral to medial respectively.

Fix (1975) studied the cerebellar nuclei of the spider monkey and described four nuclear masses which were identical with those described in the human cerebellum by Stilling (1864).

Chusid (1976) applied the classification given by Stilling.(1864) on the human cerebellar nuclei.

Carpenter (1976) described also the same four nuclei of Stilling (1864) in the human cerebellum. In the cerebellum of the cat, he postulated the existence of four nuclei which were the nucleus lateralis, the nucleus interpositus anterior, the nucleus interpositus posterior, and the nucleus medialis.

William and Warwick (1980) described also the four classical nuclei in the human cerebellum i.e nucleus

fastigii, nucleus globosus, nucleus emboliformis, and nucleus dentatus.

Icardo, Ojeda, Garcia - Porrero, and Hurle (1982) described the four classical nuclei of the human cerebellum i.e dentate, emboliform, globose, and fastigial.

II. Configuration and topography of the dentate nucleus

Weidenreich (1899) described the mammalian nucleus lateralis as having an outer convex border and an inner concave one, he also described an anatomical connection between this nucleus and the nucleus lateralis anterior.

Hatschek (1907) added that, the nucleus lateralis of higher mammals was large in size, and became serrated in shape to form the dentate nucleus.

Brunner (1919) in his wide comparative study among vertebrates stated that, the three cerebellar nuclear masses of lower mammals were interconnected by cellular bridges, he also considered the term dentate as a misnomer for the lateral nucleus of subanthropoids, as it showed no corrugations and its borders were smooth.

Tilney (1927) confirmed the findings of Brunner (1919), moreover he stated that, the lateral group

of nuclei i.e dentate and emboliform nuclei exhibited marked variations in shape, dimensions and coefficients throughout the mammalian series, being highly developed in primates reaching its most complex form in man. He explained this evolutionary process by the transition from the quadrupedal state to the bipedal and bimanal adaptation. He concluded that these nuclei were concerned with the neokinetic functions i.e learned skilled movements particularly of the hands.

Mussen (1927) in his study on the cat and monkey reported that, the two lateral cerebellar nuclei i.e nucleus lateralis and nucleus interpositus anterior were fused together.

Larsell (1937) studied the evolution of the cerebellar nuclei in vertebrates and declared that, the lateral nucleus was the most recently developed of the cerebellar nuclei, moreover the size and shape of this nucleus was determined by the degree of developement of the neocortex i.e the ansiform lobule and the paraflocculus. In reptiles he described the lateral nucleus as forming a single mass of cells,in lower mammals this nucleus was differentiated into nucleus lateralis and nucleus interpositus, in man the dentate nucleus was large in size and corrugated in shape.

Jansen et al. (1940) confirmed the fusion between the nucleus lateralis and nucleus interpositus previously described by Mussen (1927), in their investigations on the rabbit and cat.

Snider (1940) studied the cerebellar nuclei in rabbits and cats. He reported findings similar to those given by Jansen et al. (1940) concerning the fusion between the nucleus lateralis and the nucleus interpositus anterior.

Ranson (1943) described the human dentate nucleus as a crumpled purse-like lamina of grey matter within the centre of the medullary body of each cerebellar hemisphere. He described a resemblance in appearance between it and the inferior olivary nucleus, both were corrugated with a white centre and a medially placed hilus.

Dotty (1948) illustrated another relation between the cerebellar and olivary nuclei, in the sparrow she described the cerebellar nuclei as forming a single convoluted mass of cells, she postulated that the degree of convolution of the cerebellar nuclei of that bird was depending upon two factors : the degree of developement of the inferior olive and the degree of physical activity of the bird.

Rand (1954) described the appearance of the dentate nucleus in monkey in serial transverse sections, from