THE LATERAL NUCLEUS OF THE DOLPHIN AMYGDALA: main subdivisions and calretinin immunoreactivity

Introduction

The amygdala mediates emotional responses to cortical and thalamic inputs, plays a role in generation and consolidation of emotional memories and provides evaluation of the environment for potential threats. The lateral nucleus is the main input region of the amygdala: the major part of inputs sent from other brain regions reach this nucleus which provides to send stimuli to other nuclei of the amygdala and to higher brain structures. In toothed whales some structures that project to the lateral nucleus, as the cortex and the acoustic pathways, are highly developed. In particular, the latter one plays a fundamental role in the life of these animals as it constitutes the main modality through which they perceive the surrounding environment. Therefore the lateral nucleus of these marine mammals is expected to be extremely developed. Here we provide the first data on the topography and morphometry of the lateral nucleus in the bottlenose dolphin, describing its dimensions, main subdivisions and investigating the distribution of calretinin (CR ) immunoreactivity.

Materials and methods

Entire amygdala of three bottlenose dolphins

Nissl staining

immunohistochemistry

Results

In the bottlenose dolphin, as in primates, the high development of the cerebral cortex results in a lateral rotation of the amygdala and the entire temporal lobe. The lateral nucleus, observable in every coronal section from the rostral to the caudal end, is the most developed structure of the amygdaloid complex of the bottlenose dolphin and it reaches an area of 1 cm² at its point of maximal extension.

Conclusions

The general topography of the lateral nucleus of the bottlenose amygdala is very similar to that observed in monkey. A relevant feature of the bottlenose dolphin lateral nucleus is represented by its great number of subdivisions. In fact, while the literature reported three subdivisions in rat, four in monkey and only two in human, we identified five cytoarchitectonic subdivisions with one of them further separable in two parts (inner and outer). In the bottlenose dolphin, the presence of a high number of subdivisions could reveal an outstanding capability of elaboration. It could be hypothesized that the afferent feature together with the remarkable size of this nucleus could increase the ability of bottlenose dolphins to elaborate and confer emotional significance to external stimuli. The majority (95%) of CR-immunoreactive cells is non-pyramidal and resembles inhibitory interneurons. In the lateral nucleus of the bottlenose dolphin almost all CR-immunostained non-pyramidal neurons (80%) are represented by polygonal cells. This result contrasts in part with what described in human, rat and monkey where the majority of CR-immunoreactive cells of the lateral nucleus consists of both small spherical and multipolar neurons. However, in comparison with the lateral nucleus of the rat, a higher number of large multipolar stained neurons have been described in monkey. As in the rat, the lateral nucleus of the bottlenose dolphin amygdala contains a low percentage (almost 5%) of CR-immunoreactive pyramidal cells that could correspond to projecting neurons. Tipped. Here we provide, in addition to the local circuit neurons, CR-immunoreactivity is also located in neurons that connect the lateral nucleus with other amygdaloid nuclei as well as other brain areas. In conclusion, our analysis highlights some similarities in the chemoarchitectonic and intrinsic anatomical organization of the lateral nucleus of the bottlenose dolphin, rodents and primates amygdala, together with some dissimilarities , which might be related to differences in the function of this complex brain structure.