IJAE
Vol. 121, n. 1 (Supplement): 13, 2016
ITALIAN JOURNAL OF ANATOMY AND EMBRYOLOGY

Functional anatomy of cortical areas characterized by Von Economo neurons

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Von Economo's neurons (VENs) are large, bipolar or corkscrew-shaped neurons located in layers III and V of the frontoinsular and the anterior cingulate cortices. VENs are reported to be altered in pathologies such as frontotemporal dementia and autism, in which the individual's self control is seriously compromised. We have recently reviewed the evolutionary appearance of VENs and we are currently studying their distribution in different neurodegenerative diseases. To investigate the role of VENs in the active human brain, we have explored the functional connectivity of brain areas containing VENs by analyzing resting state functional connectivity (rsFC) in 20 healthy volunteers. Our results show that cortical areas containing VENs form a network of frontoparietal functional connectivity. With the use of fuzzy clustering techniques, we find that this network comprises four sub-networks: the first network cluster resembles a "saliency detection" attentional network, which includes superior frontal cortex (Brodmann's Area, BA 10), inferior parietal lobe, anterior insula, and dorsal anterior cingulate cortex; the second cluster, part of a "sensory-motor network", comprises the superior temporal, precentral and postcentral areas; the third cluster consists of frontal ventromedial and ventrodorsal areas constituted by parts of the "anterior default mode network"; and the fourth cluster encompasses dorsal anterior cingulate cortex, dorsomedial prefrontal, and superior frontal (BA 10) areas, resembling the anterior part of the "dorsal attentional network". Thus, the network that emerges from analyzing functional connectivity among areas that are known to contain VENs is primarily involved in functions of saliency detection and self-regulation. In addition, parts of this network constitute sub-networks that partially overlap with the default mode, the sensory-motor and the dorsal attentional networks.

This work was supported by grants from PROGETTO TRASLAZIONALE, Department of Neuroscience, University of Torino

Keywords

Von Economo neurons; insula; frontotemporal cortex.