Annals of General Psychiatry

Poster presentation

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Fractal analysis of dendritic arborization patterns of pyramidal neurons in human basolateral amygdala

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from International Society on Brain and Behaviour: 3rd International Congress on Brain and Behaviour
Thessaloniki, Greece. 28 November – 2 December 2007

Published: 17 April 2008

Annals of General Psychiatry 2008, **7**(Suppl 1):S141 doi:10.1186/1744-859X-7-S1-S141

This abstract is available from: http://www.annals-general-psychiatry.com/content/7/S1/S141

Background

It is well known that there is important role of amygdala in emotional-cognitive processes, i.e. in emotional and associative learning, fear acquisition and emotional memory [1]. We investigated dendritic branching patterns of pyramidal neurons which are believed to be excitatory. According to our earlier findings pyramidal neurons in human basolateral amygdala have two subtypes - pyramidal slender and pyramidal squat neurons [2]. Fractal analysis, which comes from Mandelbrot's fractal geometry [3], is used as a tool for differentiation of the complexity of neuronal dendritic branching patterns. The measure of dendritic branching represents the fractal dimension of the neuron. In performing this study, we have applied the fractal analysis to the images of neurons, in order to investigate its capability to distinguish between subtypes.

Materials and methods

The images of 14 Golgi-impregnated neurons were classified into two categories based on their somata and dendritic patterns - pyramidal slender and pyramidal squat subtypes. All images were analyzed with the box-counting method using public domain Image J software [4].

Results

Statistical analysis of the obtained data indicated that there was a significant difference ($p<0.05$) between the calculated means of fractal dimensions between dendritic arbors of two subtypes - slender and squat pyramidal neurons.

Conclusions

This preliminary study of neuronal structure performed on pyramidal neurons of human basolateral amygdala suggests the utility both of fractal analysis and fractal dimension as a useful parameter of the complexity of dendritic structure and indicates their functional complexity.

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