DNA endoreplication in the brain neurons during body growth of an adult slug

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It has been hypothesized that the size of neurons of gastropods becomes larger in parallel with an increase in body size. DNA endoreplication, i.e. DNA synthesis without cell division, is thought to be involved in this process to meet the increasing demand for macromolecules in neurons. There is, however, no experimental evidence for this hypothesis to date. Here we investigated quantitatively: (1) the size of the brain and each ganglion, (2) the size of identified neurons, (3) the total number of neurons undergoing DNA endoreplication, (4) the total number of the neurons containing a cardioexcitatory peptide, and (5) the gene expression level per neuron, using adult terrestrial slugs whose body growth was regulated through the amount of food supplied. The body growth was accompanied by increases in the sizes of both neurons and ganglia, and triggered more frequent DNA endoreplication events in each ganglion of the growth-promoted slugs, without increasing the total number of neurons. Increase in the neuronal size also involved the increase in the amount of transcripts expressed in a single neuron. This is the first quantitative evidence showing that the DNA endoreplication, neuronal size, and gene expression are increased concomitantly with body growth in adult slugs.