examined whether the inositol 1,4,5-trisphosphate (IP₃)-induced Ca²⁺ release (IICR) is involved in the regulation of the synaptic clustering of GABA_ARs. In hippocampal neurons from mice lacking intracellular Ca²⁺ releasing channel IP₃ receptor type 1 (IP₃R1), clusters of GABA_AR and those of its scaffold protein gephyrin were significantly smaller than in wild type neurons. In wild type neurons, the inhibition of IICR by specific inhibitors resulted in the decrease in GABA_AR and gephyrin cluster size, without reducing the amount of GABA_AR on the cell surface. Single particle tracking with quantum dot (QD-SPT) revealed that the loss of IP₃R1 and inhibition of IICR enhanced the lateral diffusion of GABA_ARs. The increase of GABA_AR lateral mobility resulting from the loss of IICR was completely prevented by an inhibitor of calcineurin. Our results suggest that IP₃/Ca²⁺ signaling contributes to the stabilization of synaptic GABA_A R clusters through the regulation of GABA_A R lateral diffusion, possibly through phosphorylation.

3PT207 海馬でのアクチビンによるシナプス可塑性の急性制御

Acute Modulation of Synaptic Plasticity of Pyramidal Neurons by Activin in Adult Hippocampus

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Activin is known as a sex-hormone in mammalian. We attempt to reveal the role of activin as a neuromodulator in the adult hippocampus. Activin is a homodimer of inhibin β, and activin belong to the superfamily of transforming growth factor-β (TGF-β). We showed endogenous/basal expression of activin in the hippocampal neurons. Localization of activin receptors in spines was demonstrated by immunoelectron microscopy. The incubation of hippocampal acute slices with activin A altered the density and morphology of spines in CA1 pyramidal neurons. The total spine density was increased by activin treatments. Activin increased the head diameter of spines. Blocking of MAPK, PKA or PKC prevented the activin-induced spinogenesis by reducing the density of spines. We also demonstrated that activin induced the long term potentiation (LTP) of the hippocampal neurons.

3PT208 カエル神経筋接合部シナプスでの細胞外 Ca²⁺濃度変化による神経伝達物質放出量増加の二項分布解析

Binomial distribution analysis of increase of transmitter release depending on [Ca²⁺]_e at the frog neuromuscular junction

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To investigate the action of Ca²⁺ to induce the transmitter release, we analyzed the dependency of quantal release parameters on extracellular Ca²⁺ concentration ([Ca²⁺]_e). Binomial distribution analysis with two parameters, release probability (*p*) and number of releasable synaptic vesicles (*n*) having that release probability was applied to the release induced by single stimulations at frog neuromuscular junction. Endplate potentials (EPPs) and miniature endplate potentials (MEPPs) were electrically recorded with an intracellular glass microelectrode under five different [Ca²⁺]_e changed from 0.55mM to 0.95mM at intervals of 0.10mM. The averaged size of EPPs was proportional to the about 3.0-3.5 power of [Ca²⁺]_e. The binominal analysis of EPPs distribution with using MEPPs distribution as single unit event gave values of *p* about 0.1-0.5 and *n* about 10-50. Detail analysis of the change of two parameters, *p* and *n*, showed *p* was approximately proportional to [Ca²⁺]_e and *n* was proportional to the about square of that. It suggests that increase of *n* contributed largely and increase of *p* contributed slightly to increase of transmitter release with change of [Ca²⁺]_e.

3PT209 アミロイドβペプチドが及ぼす神経活動への影響とチモキノンによる保護効果の検討

Thymoquinone, the Nigella sativa Bioactive Compound, Prevents β amyloid neurotoxicity in cultured rat primary neurons

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Alzheimer disease (AD) is a neurodegenerative disease characterized by extracellular abnormal accumulation and extensive deposition of amyloid beta peptide (Aβ). This accumulation is associated with oxidative damage, inflammatory reactions, synaptic function impairment, synaptic loss and finally leads to neuronal death, and the use of antioxidants and anti-inflammations could reduce this risk. Thymoquinone (TQ), the abundant essential oil compound of Nigella sativa L. seeds, known to be the active principle

responsible for many of the seed's antioxidant and anti-inflammatory effects, was used in this study. In every experience, rat cultured embryonic hippocampal and cortical neurons were treated simultaneously with Aβ1-42 and TQ for 72 h. The results showed that co-treatment with TQ efficiently attenuated Aβ1-42-induced neurotoxicity, as evidenced by the improved cell viability. In addition, TQ inhibited the mitochondrial membrane potential depolarization and reactive oxygen species generation caused by Aβ1-42. TQ also restored synaptic vesicle recycling inhibition, partially reversed the loss of spontaneous activity, and inhibited Aβ1-42 aggregation. These beneficial effects may contribute to the protection against Aβ-induced neurotoxicity. Together, our results suggest that the natural antioxidant TQ has potential for neuroprotection and therefore, may be a promising candidate for AD treatment.

3PT210 インスリンを介した神経シグナルによって制御される線虫 *C. elegans* の温度適応の解析

Insulin-mediated neural signals negatively regulate temperature tolerance in *C. elegans*

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Temperature is one of the most critical environmental stimuli and cause biochemical change in the body. Therefore, animals have adaptation mechanisms against environmental temperature changes, however, its molecular mechanisms are still poorly understood. Here we show that *C. elegans* has a cultivation temperature-dependent cold resistance, which is regulated by insulin-mediated pathway. 25°C-grown wild-type animals isolated from U.K. were destroyed by cold stimuli, 2°C for 48hr. By contrast, most of 15°C-grown wild-type animals can survive for 48 hours at 2°C. These facts suggests that *C. elegans* has cold resistance with changes in environmental temperature. To reveal the molecular mechanisms underlying the cold resistance, we measured cold-resistance in the various mutant animals defective in temperature sensation and temperature-controlled hormonal signaling. We found that the mutants defective in insulin-like molecule DAF-28, insulin receptor DAF-2 and its downstream molecules showed enhancement in cold resistance. These results suggest that insulin-mediated neural signals negatively regulate cold resistance. In another approach, we focused on the natural variation of wild-type strains isolated from different areas. We so far found that British strain showed weaker phenotypes in cold resistance than California or Vancouver strains, respectively. We are also using artificial evolution approaches and forward genetic screening to isolate the mutation in cold resistance.

3PT211 海馬での年齢依存的な性ホルモン受容体・合成酵素遺伝子の発現変動解析

Age-related changes in the expression of mRNAs encoding for sex steroidogenic enzymes and sex hormone receptors in the hippocampus

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Although sex steroids play a crucial role in the development/maintenance of brain function, the age-related changes in the hippocampal sex steroidogenesis remain largely unknown. We examined the mRNA expression levels of sex steroidogenic enzymes and sex steroid receptors in the hippocampus of aged (24 month-old) male rats compared with those of young adult (3 month-old) male rats by means of semi-quantitative RT-PCR. The levels of mRNAs for cytochrome P45017 α, 17 β -HSD3 and 5 α -reductase2 reduced in the hippocampus of aged rats to approx. 45%, 76% and 75% of young adult rats, respectively. On the other hand, the levels of 17β-HSD1, 5α-reductase1 and P450aromatase were almost the same between aged and young adult hippocampus. The levels of estrogen receptor β and androgen receptor reduced in aged hippocampus to approx. 84% and 55% of young adult hippocampus, respectively, while almost no change was observed in the mRNA expression of estrogen receptor α between aged and young adult hippocampus. These results indicate that the hippocampal sex steroidogenic properties are substantially altered between aged and young animals.

3PT212 NMDA 受容体と相互作用することにより CaMKII は分子メモリとして機能する - *in vitro* 実験系による実証 -

CaMKII functions as a molecular memory through interaction with NMDA receptors - validation in *in vitro* experiments -