Sudomotor function evaluated by the quantitative sudomotor axon reflex test (QSART) in pure autonomic failure, Parkinson's disease and multiple system atrophy

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[Background] Whether sudomotor function is disturbed in degenerative diseases of the nervous system with autonomic failure has not been investigated in detail. [AIM] This study aims to clarify the sudmotor function in pure autonomic failure (PAF), Parkinson's disease with orthostatic hypotension (PD-OH), and multiple system atrophy with OH (MSA-OH) with quantitative sudomotor axon reflex sweat test (QSART). [Methods] QSART and 123 I-MIBG myocardial scintigraphy were performed in four patients with PAF, 9 with PD-OH, and 5 with MSA-PD. Age-matched healthy controls (C groups) were recruited for each test. [Results] 1. QSART: a) Forearm: PAF showed a tendency of reduction in sweat response as compared to C group ($p < 0.1$). Sweat response was normal in PD-OH and MSA-OH. b) Lower leg: PAF and MSA-OH showed significantly lower sweat responses than C group ($p < 0.01$, $p < 0.05$, respectively). There was no differences in sweat response between PD-OH and the other 3 groups. 2. MIBG myocardial scintigraphy: MIBG uptake; Values in PAF and PD-OH were significantly lower than in MSA-OH group and C group (all $p < 0.001$). [Conclusions] Sudomotor impairment begins from the lower legs in PAF and MSA-OH. On the other hand, sudomotor function is preserved in contrast to cardiac sympathetic nervous dysfunction in PD-OH.

Muscle blood flow responses mapped in the rat autonomic ventrolateral medulla areas with microinjections of an ionotropic excitatory amino acid L-cysteine

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Microinjections of the semi-essential sulfur containing amino acid L-cysteine into a site in the rostral ventrolateral medulla (RVLM) pre-sympathetic area of rats produce a pressor response and those into a site in the caudal VLM (CVLM) produce a depressor response, both via ionotropic excitatory amino acid receptors alone different from L-glutamate which also activates additional metabotropic ones (Amino Acids 46: 863-872, 2014; Auton Neurosci 186: 45-53, 2014). The current study aimed to examine muscle blood flow responses to L-cysteine mapped in VLM areas including pre-sympathetic and pre-adrenal motor neurons. In urethane and alpha-chloralose anesthetized rats which were opened the VLM surface, arterial blood pressure (ABP), hindquarter blood flow (HQF) and resistance (HQR; ABP divided by HQF) were recorded. Mapping of L-cysteine microinjections resulted in vasoconstriction or vasodilation in the RVLM area and mainly vasodilation in the CVLM area. These changes in HQR were significantly correlated to changes in ABP. Several sites where L-cysteine produced the vasodilation in the RVLM may be through adrenaline release. Peripheral beta-adrenoceptor blocking with propranolol IV injection in rats significantly reduced HQR responses to re-microinjections of L-cysteine, suggesting that L-cysteine microinjections stimulated adrenaline release from the adrenal medulla via a site within the RVLM area. The results indicate that 1) L-cysteine affects ABP via muscle blood flow regulation in the autonomic VLM areas, and 2) several sites in the RVLM area sensitive to L-cysteine stimulation would be related to regulation of pre-adrenal sympathetic nervous activation, possibly via ionotropic excitatory amino acids receptors.

Striatal dopamine transporter abnormalities in pure autonomic failure and speculation about the relationship with Lewy bodies

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Background: Whether pure autonomic failure (PAF) is a prodromal state of PD and DLB is not clear. However, dopamine transporter (DAT) function in PAF will help elucidate why the majority of patients with PAF experience only autonomic dysfunction and seldom progress to motor dysfunction and dementia. Aim: We objected to reveal DAT abnormalities in PAF and speculate about the relationship with the Lewy body pathology progression pathway. Methods: We performed DAT SPECT in patients with PAF. Results: The subjects were four patients with PAF (3 males, 1female). Orthostatic hypotension, constipation, hypohidrosis, RBD and slight olfactory dysfunction were observed in the absence of parkinsonism. Striatal FP-CIT accumulation in patients with PAF were visually abnormal. Semi-quantification of those were lower than normal controls, but higher than PD and DLB. Motor dysfunction is observed in PD when more than 50% of dopaminergic neurons are lost. Slight dopaminergic neuronal dysfunction in PAF may precede the onset of motor dysfunction. Some patients with PAF develop PD or DLB after long-term observation. However most of patients with PAF remain to be autonomic dysfunction in some decades. Some factors that suppress progression to motor dysfunction may exist in PAF. Since olfactory function is relatively spared, PAF may be pathogenetically distinct from PD and DLB. Conclusions: Slight striatal DAT abnormalities were observed in most patients with PAF. We speculate that PAF has a disease progression pathway that is distinct from PD and DLB.

Colonic transit can be measured by geometric center analysis for time-course on non-anesthesia rat

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We reported that colonic transit was measured for time-course analysis by the method using radiopaque markers. However, we had measured colonic transit by the maximum migration length of the marker, which was done by the geometric center on previous other studies. Therefore, aim of the present study is to assess colonic transit of normal conscious rats calculating the geometric center. Twenty metal radiopaque markers were administrated into the proximal colon with saline using an in-dwelling silastic cannula. It was visible throughout the gastrointestinal tract via soft X-ray when the first maker output with fecal pellet. Just after imaging in vivo, the entire colon was surgically removed and imaged. Colonic transit was calculated by the geometric center on the images of those. It is possible calculating the geometric center at the time of the first marker output using the method. Then, the measurement could perform each 30 minutes for 2 consecutive days and the reproducibility was demonstrated. Moreover, we confirmed influence of parasympathetic nerve activity on colonic transit using the geometric center analysis. The measurement was performed with intraperitoneal injection of vehicle on day1 and atropine or neostigmine on day2 before markers administrated. Colonic transit was accelerated by neostigmine, although it was not changed by atropine. These results suggest that 1) colonic transit could be measured using our new method by the geometric center, 2) the measurement could performed for time-course analysis and 2 consecutive days, and 3) autonomic nerve system on colonic transit could be observed by the method.

Evaluation of autonomic nervous function using heart rate variability analysis during heart rate reduction by manual acupuncture

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BACKGROUND: In previous studies, significant changes in autonomic nervous functions during heart rate reduction response due to manual acupuncture stimulation by sparrow pecking method do not seem to be reported by heart rate variation analysis (HRV analysis, below). AIM: The aim of this study is to evaluate the changes in autonomic nervous functions involve heart rate reduction during manual acupuncture stimulation by HRV analysis. METHODS: The 25 healthy male were participated. While measuring the electrocardiogram, they received acupuncture stimulations in their left hands Shousanli (LI 10) points at 1 HZ, depth 15 - 20 mm for 140 seconds. Instantaneous heart rate and HFn.u. (index of cardiac vagal activity) and LF / HF (index of balance between cardiac sympathetic nervous activity and cardiac vagal activity) before, during and after acupuncture stimulation were calculated. RESULTS: The heart rate decreased significantly with acupuncture stimulation and returned to its original level after stimulation. With acupuncture stimulation, HFn.u. increased significantly, and LF / HF decreased significantly. After acupuncture stimulation, HFn.u. increased significantly from the level during acupuncture stimulation, and LF / HF remained decreased. CONCLUSIONS: By HRV analysis, it was confirmed that manual acupuncture stimulation transiently decreased heart rate and made autonomic nervous activity be relative parasympathetic nervous dominance.

Activation of autonomic nervous system and arginine vasopressin (AVP) synthesis in the central nerve system after peripheral administration of furosemide in AVP-eGFP transgenic rat

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Furosemide is essential medications for fluid overload. On the other hand, it have been reported severe adverse effects such as sympathetic nervous activation. Previous studies reported that there were interaction between sympathetic system and arginine vasopressin (AVP) synthesis. However, AVP synthesis in the hypothalamus after peripheral administration of furosemide remains unclear. We have generated transgenic rats expressing an AVP-enhanced green fluorescent protein (eGFP) fusion gene. In this study, we investigated AVP-eGFP synthesis in the hypothalamus after peripheral administration of furosemide, using the transgenic rats. We assessed eGFP fluorescence in the supraoptic (SON) and the paraventricular nuclei (PVN) after intraperitoneal (i.p.) administration of furosemide in the transgenic rats. Secondly, we counted Fos-immunoreactivity (Fos-ir) cells in the hypothalamus and other brain regions that were responsible for control of sympathetic activity. Futhermore, we also investigated the AVP gene expression in the SON and the PVN of transgenic rats using *in situ* hybridization histochemistry. In the furosemide groups, eGFP fluorescent intensities in the SON and the PVN after administration were significantly increased in comparison with controls. The eGFP-expresing neurons in the SON and the PVN after administration of furosemide were significantly activated. AVP heteronuclear (hn) RNA levels in the SON and the PVN were dramatically increased after administration of furosemide. Fos-ir cells in the locus ceruleus (LC) and the rostral ventrolateral medulla (RVLM) were increased after administration of furosemide. We were able to visualize and quantitatively evaluate upregulation of AVP-eGFP synthesis and neuronal activations after peripheral administration of furosemide, using the AVP-eGFP transgenic rats.

Cutaneous sympathetic function in patients with cortical cerebellar atrophy.

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Background: Physiological stimulation evokes transient increase of the sweating and decrease of blood flow in the palms and soles. These responses are known as sympathetic sweat response and skin vasomotor reflex, respectively. There are few reports about cutaneous sympathetic function of cortical cerebellar atrophy, which accounts for a one-third of sporadic cerebellar ataxia in Japan. **Aim:** We evaluate cutaneous sympathetic function in patients with cortical cerebellar atrophy. **Methods:** We assessed sympathetic sweat response and skin vasomotor reflex in 14 cortical cerebellar atrophy patients (6 males, 9 females, mean age: 61±17 years, disease duration: 5.6±4.2 years) and 14 healthy controls. Sympathetic sweat response amplitude was measured from baseline to the peak, and skin vasomotor reflex reduction rate was calculated by the value that divided reduced flow in basal flow in the palms, respectively. As physiological stimulation, we used deep inspiration, mental arithmetic and exercise. **Results:** There were no significant differences in the mean sympathetic sweat response amplitude (ml/cm^2/min) for deep inspiration (cortical cerebellar atrophy: 0.12±0.15, controls: 0.20±0.23), mental arithmetic (0.19±0.24, 0.26±0.20) and exercise (0.24±0.28, 0.23±0.18) between cortical cerebellar atrophy patients and controls. There were also no significant differences in the mean skin vasomotor reflex reduction rate (%) for deep inspiration (64±17, 56±25), mental arithmetic (48±14, 44±26) and exercise (56±16, 46±27) between two groups. **Conclusions:** Cutaneous sympathetic function in cortical cerebellar atrophy patients is maintained. It may be reflected that the frontal lobe, limbic system and brainstem reticular formation, which regulate cutaneous sympathetic function, are not usually affected in cortical cerebellar atrophy.

Increased Expression of the (Pro)renin Receptor in the Subfornical Organ of Hypertensive Humans

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We previously reported that (pro)renin receptor (PRR) is functionally important in the subfornical organ (SFO) of the brain, a key brain circumventricular organ that is involved in BP regulation and body fluid homeostasis. The SFO PRR mediates Ang II formation and is critical for hypertension development and body fluid homeostasis in hypertensive animal models. However, it is not known whether PRR expression level is altered in hypertensive humans or what is the cellular distribution. We have collected human subfornical organ (SFO) tissues post mortem, 14 of which were clinically diagnosed hypertensive and 7 of which were diagnosed normotensive. Systolic (SBP) and diastolic (DBP) blood pressure, age, body weight, and medications used information were collected. SFO tissues were fixed in 10% formaldehyde and processed for paraffin embedding and sectioning. The age and body weight patterns are similar between the normotensive and hypertensive subjects. Regardless of anti-hypertension medications, the SBP was significantly higher in clinically diagnosed hypertensive (142.4 $\pm$ 4.2 mmHg) subjects compared with the normotensive (118.1 $\pm$ 7.7, *P*=0.007) subjects. There is no difference in DBP between these two groups (74.1$\pm$5. VS. 79.29$\pm$3.5). SFO sections were used for immunofluorescence double labeling of human PRR with neuronal marker (anti–human neuronal protein HuC/HuD), astrocyte marker (glial fibrillary acidic protein, GFAP), or microglia marker (ionized calcium-binding adaptor molecule 1, Iba1). We found that the human PRR was colocalized only with the HuC/HuD but not GFAP or Iba1, which suggests that PRR is majorly expressed in the neurons of human SFO. To examine whether there is an alteration of PRR expression in the hypertensive humans, we performed immunohistochemistry labeling of PRR in these tissues. The PRR immuno-reactivity was significantly higher in the hypertensive subjects (145.3 $\pm$ 1.4 Arbitrary Units, AU) compared with the normotensive subjects (135.5 $\pm$1.2 AU, *P*=0.0002). In addition, there is significantly positive correlation between the PRR expression level and the SBP (Pearson r=0.55, R^2=0.308, *P*=0.018) among all normotensive and hypertensive subjects. The data suggests that PRR expression level is elevated in the SFO of hypertensive subjects and that there is positive correlation between PRR expression level in the SFO and systolic BP. We conclude that PRR in the SFO may play an important role in the body fluid homeostasis and hypertension development in humans.

Reduction in prefrontal oxygenation during exposure to positively-charged emotional movie in humans

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We examined the response in the prefrontal oxygenation during audiovisually-elicited emotional stimulation for 2 min (comedy, landscape, and horror movie) in humans. The concentrations of oxygenated-hemoglobin (Oxy-Hb) and deoxygenated-hemoglobin (Deoxy-Hb) in bilateral prefrontal cortices were measured with near-infrared spectroscopy to monitor regional cerebral blood flow. Simultaneously, regional facial skin blood flow and vascular conductance were assessed with noninvasive two-dimensional laser speckle flowmetry, and forehead and limb skin blood flows were measured with laser-Doppler flowmetry. The extents of pleasantness and consciousness for each emotional stimulus were estimated by the subjective ratings of pleasantness and consciousness from -5 (the most unpleasant; the most unconscious) to +5 (the most pleasant; the most conscious). As soon as comedy movie was exposed, the Oxy-Hb of bilateral prefrontal cortices decreased without changing the Deoxy-Hb. Facial skin blood flow and vascular conductance were also decreased during viewing comedy movie. The decrease in the prefrontal oxygenation had a highly-significant correlation with the decrease in facial skin blood flow. On the other hand, the prefrontal Oxy-Hb tended to increase during viewing horror movie and did not change during viewing landscape movie. The time courses and magnitudes of the prefrontal Oxy and Deoxy-Hb responses matched on both sides. The present findings suggest that positive emotion induces reduction in prefrontal oxygenation, which may in turn elicit a decrease in facial skin blood flow.

Effects of Electro-acupuncture and Indirect Moxibustion via Central Oxytocin on Gastric Emptying in Rats

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Background: Restraint stress inhibits gastric emptying (GE) via a central corticotropin-releasing factor (CRF) type2 receptor and peripheral sympathetic neural pathway. Moreover, electro-acupuncture (EA) and indirect moxibustion (iMOX) at Zusanli (ST36) improve stress-induced delayed GE via a supraspinal somato-autonomic reflex. In contrast, central oxytocin attenuates the response of the colonic function to stress via inhibiting corticotrophin-releasing factor (CRF) expression in the hypothalamus. However, involvement of central oxytocin in EA- and iMOX-induced optimal results on GE remains unknown. Aim: This study was to investigate whether the EA and iMOX at ST-36 improve restraint stress-induced delayed GE via the central oxytocin. Methods: Rats were fed solid food after a 24-h fasting. Immediately after food ingestion, the rats were subjected to restraint stress. Ninety minutes after the feeding, the rats were euthanized and their gastric contents were removed to calculate GE. EA or iMOX was performed at the bilateral ST-36 throughout stress loading. To investigate whether central oxytocin was involved in mediating the stress-induced alterations of GE by EA and iMOX, an oxytocin antagonist was administrated (intracerebroventricularly) immediately after initiating of restraint stress. Results: GE in the 90-min study period was significantly delayed by restraint stress. This delayed GE was significantly accelerated by not only EA but also iMOX. The improvement in GE induced by EA and iMOX disappeared upon oxytocin antagonist injection to the lateral ventricle. Conclusion: Endogenous central oxytocin is involved in mediating the stimulatory effects of EA and iMOX on restraint stress-induced delayed GE.

Development of NO-ergic synaptic sympathetic transmission

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NO is generated by the enzyme nitric oxide synthase (NOS) and acts as a neuromodulator in the sensory and autonomic neurons. A large number of adult mammalian sympathetic preganglionic neurons express NOS. However, there are only few works concerning the development of NO-mediated synaptic transmission in the sympathetic ganglia. The aim of this study was to identify expression of NOS in sympathetic preganglionic neurons and effects of NO on synaptic transmission in sympathetic ganglia during development. Experiments were performed on rats of different ages (newborn, 10-day-old, 20-day-old, 30-day-old, 180-day-old, 3-year-old) using immunohistochemistry, electrophysiology and western-blotting. The results showed that in all age groups NOS-immunoreactive (IR) neurons were absent in sympathetic ganglia. During the first month of life, the proportion of NOS-IR neurons decreased significantly, while the number of neurons containing choline acetyltransferase increased. In newborns, all preganglionic neurons were NOS-IR while in one-month-old rats 30-35% of preganglionic sympathetic spinal neurons were NOS-immunonegative. Decreasing in the expression of NOS in the spinal cord in the first month of life was confirmed by western blotting. Evoked synaptic potentials in the superior cervical sympathetic ganglion were inhibited with NO donor sodium nitroprusside and augmented by the NO synthase inhibitor L-NAME. Thus, in early postnatal ontogenesis, there is an age-related change in NO-ergic sympathetic transmission with in a decrease in the number of sympathetic preganglionic neurons expressing NOS. NO inhibits synaptic transmission in sympathetic ganglia in young and old rats.
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An anti-plexin D1 autoantibody is associated with neuropathic pain and autonomic symptoms

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Background: We recently discovered an anti-plexin D1 autoantibody associated with neuropathic pain (NeP), which selectively binds to unmyelinated C fiber type dorsal root ganglion (DRG) neurons. **Aim:** We aimed to clarify clinical characteristics, including autonomic symptoms, in anti-plexin D1 autoantibody-positive patients with NeP. **Methods:** We screened for anti-plexin D1 autoantibodies using a mouse DRG tissue-based indirect immunofluorescence assay (IFA) with sera from 110 NeP patients with various inflammatory and allergic neurological diseases or other neuropathies, and from 45 controls without NeP, including 20 healthy subjects and 25 patients with neurodegenerative diseases or systemic inflammatory diseases. Tissue-based IFA-positive sera were subjected to a cell-based IFA using HeLa cells, which express plexin D1, with and without small interfering RNA against the plexin D1 mRNA. Clinical data of all patients were retrospectively collected. **Results:** Anti-plexin D1 autoantibodies were detected in 11 NeP patients (10%) and in no subjects without NeP ($P = 0.0343$). NeP patients with anti-plexin D1 IgG showed relatively young onset ages, a relapsing disease course, burning pain, thermal hyperalgesia, and abnormalities of current perception threshold for c-fibers. Autonomic symptoms were present in five patients (45.5 %). The most frequent autonomic symptoms were peripheral vascular autonomic dysfunction symptoms (swelling, skin color and temperature changes). Comorbidities included atopy (n=10 patients), collagen-vascular disease (n=4), demyelinating disease (n=3), and malignant neoplasm (n=1). Immunotherapies, such as plasma exchanges, ameliorated NeP and related autonomic symptoms in all cases treated. **Conclusions:** An anti-plexin D1 autoantibody-related neurological syndrome is clinically characterized by NeP and autonomic dysfunctions.

Choroidal structure analysis of Parkinson's syndrome by Binarization of Optical Coherence Tomography

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Purpose: The choroid, an ocular tissue, has abundant blood flow. It can be divided into vascular and interstitial regions. We reported that the choroidal thickness of patients with Parkinson 's syndrome was thinner than control group, and sympathetic dysfunction of Parkinson' s syndrome may be involved in the cause. To compare the two structural regions involved in the thinning, we investigated choroidal images using binarization processing (black and white conversion). **Subjects**: We studied 13 eyes of 13 subjects (mean age 77±7.5 years, 3 male, 10 female) with Parkinson's syndrome; in the control group, 21 eyes of 21 subjects (mean age 71±8.0 years, 8 male, 12 female) without Parkinson's syndrome. **Methods**: We captured the choroidal using Swept-Source Optical Coherence Tomography (SS-OCT:TOPCON Co., Ltd) and performed binarization processing of the images using "Image J", which is a free software. The choroid was classified into a vascular and an interstitial region, and the area ratio was obtained. **Results**: In the Parkinson's syndrome group, the total area was 290450.3±68524.1 μm^2. Area of the vascular region was 186570.8±51613.7 μm^2, and that of the interstitial region was 10389.5±19083.3 μm^2. In the control group, the total area was 358913.9±96245.1 μm^2. Area of the vascular region was 235512.5±71654.4 μm^2, and that of the interstitial region was 123401.6±26595.7 μm^2. Percentage of vascular region to total area was 64.2% in Parkinson's syndrome and 65.6% in control group ($p>0.05$). **Discussion**: Choroidal thinning by Parkinson's syndrome is a possibility caused by both vascular and interstitial regions.

Chondroitin sulfate suppresses the low-pH induced mechanical response in thin muscle afferents of rats

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Sympathetic nerve activity (SNA) is increased during exercise by the afferent inputs from the muscle, contributing to the cardiovascular response (the exercise pressor reflex). The input signals are generated by activation of muscular thin fiber afferents. We previously demonstrated that acid (pH 6.2 buffer solution) facilitates mechanical response of thin muscle afferents in rats, suggesting that SNA exaggeration is induced by the combination of the mechanical stimulus, such as muscle contractions, and acidosis seen in ischemia and/or heavy-intensity exercise. We also demonstrated that the acid-induced facilitation of the mechanically activated currents was attenuated by chondroitin sulfate (CS) in small dorsal root ganglion neurons. Here we tested whether the acid-induced facilitation of the mechanical response of thin muscle afferents was also suppressed by CS using the single-fiber recording technique. A total of 70 fibers dissected from 68 male Sprague-Dawley rats were identified and recorded. Ramp mechanical stimulus was applied to the receptive field by a rounded-tip probe. Mechanical threshold and the response magnitude of thin muscle afferents were significantly lowered and increased, respectively, by exposing the receptive field to pH 6.2 buffer solution. After the injection of CS (0.3 and 0.03%), these acid-induced changes were significantly reduced. No significant difference in the attenuation was detected between CS concentrations used. These results suggest that a proteoglycan is responsible for the modulation in acid-induced sensitization of thin muscle afferents, and that CS has potential in working against ischemic pains and exaggeration of SNA during exercise in acidosis and/or patients with peripheral artery diseases.

A detailed mechanism for sudden death in epilepsy (SUDEP) including an explanation for postical phenomenology and resuscitation success and failures.

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Sudden death in epilepsy (SUDEP) is the major cause of death among persons with epilepsy. The mechanism of SUDEP is, however, poorly understood, and no specific indicator of SUDEP events is known. Using a rat model, we demonstrated a sequence of events ending in death that begins with obstructive apnea caused by seizure-induced laryngospasm (Nakase et al., 2016). Attempts to breathe during airway occlusion eventually cease. In between the onset of obstructive apnea and respiratory arrest, the seizure stops and a bradyarrhythmia develops as a result of hypoxemia. By the time of respiratory arrest, echocardiography showed ventricular dilation and decreased ejection fraction. High frequency EMG signals were detected during extreme effort to inspire during airway obstruction and these can be used as a practical biomarker of obstructive apnea (Stewart et al., 2017). In addition, RR interval variability increases dramatically as a result of both dropped QRS complexes from conduction failures and QRS doublets and triplets in association with peak inspiratory effort. Cardiopulmonary resuscitation has been shown to prevent death when administered early (Ryvlin et al., 2013). The opportunity for CPR to support circulation and eventually overcome the laryngospasm, which weakens as the seizure abates, is based on mechanistic details of (a) airway occlusion by seizure-induced laryngospasm and (b) poor cardiac contractility and bradyarrhythmia resulting from hypoxemia. The awareness of the possibility of seizure-induced obstructive apnea, its basis, and consequences will help increase the preparedness of care-givers to administer CPR and prevent sudden death.

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On the road to neurovascular coupling in the short-tailed fruit bat, Carollia perspicillata

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Neurovascular coupling (the relation of neuronal activity to blood flow) is a fundamental feature of brain function that is widely exploited in brain imaging technologies. Techniques have been developed to image the brain vasculature of small animals in exquisite detail, affording the opportunity to assess the structural baseline of the brain vasculature. These baseline data are critical for understanding neurovascular dynamics in relation to regional brain activity and other physiological manipulations or changes. To establish the vascular anatomy of the bat brain as a complement to our forebrain atlas (Scalia et al., 2013), we used a fluorescence imaging/reconstruction methods developed by Tissue Vision (www.tissuevision.com) to map the brain vasculature of the short-tailed fruit bat, Carollia perspicillata. Individual animals were anesthetized with urethane and transcardially perfused with 4% paraformaldehyde followed by 2% gelatin containing rhodamine B isothiocyanate. Brains were imaged with an in-plane resolution of 1.2 microns per pixel, and coronal sections were spaced 50 microns throughout the brain. Detailed vascular anatomy of neuroendocrine forebrain regions such as paraventricular nucleus and supraoptic nucleus is contrasted with limbic (amygdala, hippocampus), and subcortical/cortical regions (striatum, neocortex, claustrum). The resulting full reconstruction of the brain vasculature has been used to establish additional points of comparison between bat brain and the brains of other species (e.g. Orman et al., 2017). These data are essential for identifying targets and baseline values for various experiments dependent on manipulating brain blood flow.

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Effects of High-resolution Musical Box Sounds on the Autonomic Nervous Function and Findings from Order Changes of Hearing Sounds

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Background: An experiment on high-resolution sounds conducted as preliminary research compared the effects of listening to high-resolution and high-cut sounds on autonomic nervous function. It was found that listening to high-resolution sounds resulted in greater activation of both sympathetic and parasympathetic nerve functions than listening to high-cut sounds. Objective: As the subjects listened to high-cut sounds followed by high-resolution sounds in this experiment, the influence of the order of presenting sound sources needed to be considered when interpreting the results. Patients and Methods / Material and Methods： The subjects were 27 healthy college students (aged 27.9 ± 5.8 years old). Written informed consent was obtained from the students.The students were asked to listen to high-cut (20 kHz or lower) and high-resolution sounds of music boxes, and their pulse waves were measured for one minute. FFT-based (Fast Fourier Transformation) spectral analysis for heart-rate variability was conducted to determine the low-frequency (LF) and high-frequency (HF) powers as well as their ratio (LF/HF), and the coefficient of variation of the a-a interval (CVaa) was also measured. Results： The results demonstrated that the sympathetic nerve function was more activated and the parasympathetic nerve function also tended to be activated while listening to high-resolution sounds compared with while listening to high-cut sounds. Conclusion： The results suggest that concentration and attention were lasted with the relaxed state by listening to high-resolution sounds.

Autonomic functioning, emotional regulation and sensory over-responsivity in young children with or without autism spectrum disorder

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Background. Sensory over-responsivity, autonomic and emotional dysregulation have been found in people with autism spectrum disorder (ASD). Research on the unique associations of autonomic functioning and emotional regulation with sensory responsivity in young children with or without ASD is lacked. ***Aim.*** This study aims to examine the correlates of sensory over-responsivity in these two populations. ***Methods.*** We recruited 545 typically developing children and 61 children with ASD. They were aged 3 to 6 years old. Their parents completed Sensory processing and Self-regulation Checklist which measures emotional regulation, autonomic functioning and sensory responsivity. Hierarchical linear regression models were used to examine unique associations of emotional regulation and autonomic functioning on sensory over-responsivity. ***Results.*** The typically developing group performed significantly better in autonomic functioning, emotional regulation and sensory over-responsivity than the ASD group (all *ps* < .001). Hierarchical regression analyses revealed that emotional regulation (standardized beta, *B* = .30; *p* < .001) and autonomic functioning (*B* = .24; *p* < .001) explained 14% and 6% variance of sensory over-responsivity in typically developing children, whereas emotional regulation (*B* = .47; *p* < .001) and autonomic functioning (*B* = .41; *p* < .001) explained 38% and 14% variance of sensory over-responsivity in children with ASD. ***Conclusion.*** The association of emotional regulation and autonomic functioning with sensory over-responsivity has similar pattern but greater extent in young children with ASD as compared with their normal counterpart. The findings help identifying risk factors of sensory over-responsivity in children.

Long-term exposure to microgravity impairs head-up tile-induced vestibulo-cardiovascular reflex

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Background: The vestibular system is known to have an important role in controlling arterial blood pressure upon posture transition (vestibulo-cardiovascular reflex). However, it is known that, under certain conditions such as exposure to a different gravitational environment, the vestibular system may have its sensitivity affected. Thus, it is possible that vestibulo-cardiovascular reflex becomes less sensitive after spaceflight, which would induce orthostatic intolerance. Methods and Results: The role of vestibulo-cardiovascular reflex in maintaining blood pressure upon head-up tilt was examined before and after a stay of 4–6 months in the International Space Station. At pre-spaceflight, a transient increase in blood pressure (11.9 ± 1.6 mmHg) was observed at the onset of head-up tilt. However, that increase was not seen at 1–4 days after return, when blood pressure decreased by 7.1 ± 1.9 mmHg upon head-up tilt. To transiently interrupt the vestibular-mediated pressor response, galvanic vestibular stimulation was applied, and the magnitude of vestibulo-cardiovascular reflex was calculated as the difference in the first 20 s response to head-up tilt-induced blood pressure between subjects undergoing and subjects not galvanic vestibular stimulation. Magnitude of vestibulo-cardiovascular reflex attenuated at 1–4 days after return (from 150 ± 19 mmHg·20 s at pre-spaceflight to –45 ± 18 mmHg·20 s at return) and recovered to the pre-spaceflight levels 2 months after return (118 ± 40 mmHg·20 s). Conclusions: These results indicate that a long-duration exposure to microgravity induces an impairment of vestibulo-cardiovascular reflex, which may be involved in a mechanism of spaceflight-induced orthostatic intolerance.

Behavioural and autonomic regulation of response to sensory stimuli among children: a systematic review of relationship and methodology

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Background: There is a growing interest in examining the autonomic mechanisms underlying regulation of response towards sensory stimuli. Previous studies suggested correlation between behavioural and physiological responses related to sensory reactivity among children. However, contrasting results has been reported. **Aim**: For better understanding, this review is performed to systematically review and critically appraise the current evidence on the relationship between behavioural and physiologic regulation of response to sensory stimuli among children; and describe the methods used in these studies. **Methods**: Online databases which includes EBSCO, MEDLINE, CINAHL, ProQuest and BioMed Central were systematically searched using the following search terms and their combinations: 1) autonomic* or ANS or PNS or SNS; and 2) sensory* or SI or SPD. Peer-reviewed, full-text articles in the English language published between 1999-2016. Articles were appraised by two independent review authors for level of evidence and quality. **Results**: The initial search tier yielded 1217 articles, and screening and appraisal, 14 Level III-3 cross-sectional studies for were included for systematic review. Only six studies explored the relationship between behaviour and physiologic regulation of response to sensory stimuli, which yielded incongruent results. Behavioural measures, physiological measures and experimental laboratory paradigms are succinctly described. **Conclusion**: Thus far, there is inconclusive evidence that supports the relationship between behavioural and physiological regulation of response to sensory stimuli in children. The heterogeneity of methodologies employed in reviewed studies may provide insight on further improving future research related to the behavioural and physiological regulation of response to sensory stimuli in children.