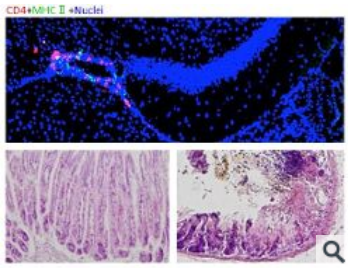
Chronic stress induces fatal organ dysfunctions via a new neural circuit

21.08.2017

New research reveals the mechanisms behind the effects of chronic stress and tiny inflammations in the brain on fatal gut failure.

Hokkaido University researchers revealed that fatal gut failure in a multiple sclerosis (MS) mouse model, EAE, under chronic stress is caused by a newly discovered nerve pathway. The findings could provide a new therapeutic strategy for the intractable disease, particularly progressive MS, which has no therapeutic strategy at present.

MS affects an estimated 2.5 million people worldwide and causes motor dysfunction, impaired vision and gastrointestinal failures. It is an autoimmune condition of the central nervous system (CNS) mediated by immune cells called autoreactive CD4+ T cells. In EAE mouse models, these pathogenic CD4+ T cells can cause a MS-like disease when transfused intravenously to healthy mice.



Micro inflammation developed at specific sites in the brain (top panel). Pathological analysis of the stomach showed damage to tissues in the stomach (bottom right) compared to mice not under stressful conditions (bottom left).
Credit: Arima Y., et al. eLife. August 15, 2017.

In previous studies using EAE mouse models, Professor Masaaki Murakami of Hokkaido University and his colleagues revealed autoreactive CD4+ T cells cross the blood-brain barrier at specific sites and cause inflammation in the CNS including the brain and spinal cord.

... more about:
» CD4+ T cells » Hokkaido » T cells » blood vessels » inflammation » mouse models » neural circuit

The emergence of a "gateway" for autoreactive CD4+ T cells to cross the barrier was caused by regional neural activation at those sites, which is triggered by specific sensory-sympathetic interactions. They termed these phenomena as gateway reflexes and have published on at least three, the gravity-, electric-, and pain-gateway reflexes.

In the present study, the team and their collaborators in Japan and Germany investigated the possible relations between chronic stress, micro-inflammation in the brain, and stress-related organ failures.

They put healthy mice under stress by disturbing their sleep or by rearing them on wet bedding. The transfer of pathogenic CD4+ T cells under the stress caused severe symptoms such as gastrointestinal failures and even sudden death. Cell transfer or stress alone did not cause these symptoms. Subsequent investigations revealed a complex nerve-related mechanism behind this process.

The injected pathogenic CD4+ T cells accumulated around blood vessels in two specific sites at the center of the brains of the stressed mice. Micro-inflammation developed around specific blood vessels, and the inflamed sites then released a small molecule called ATP that switched on a nerve pathway that is normally turned off. This switch led to gut dysfunctions, bleeding

Event News

"Lasers in Composites Symposium" in Aachen – from Science to Application
19.09.2017 | Event News

I-ESA 2018 – Call for Papers
12.09.2017 | Event News

EMBO at Basel Life, a new conference on current and emerging life science research
06.09.2017 | Event News

find and help
to the campaign page >>>

Latest News

An international team of physicists a coherent amplification effect in laser excited dielectrics
25.09.2017 | Physics and Astronomy

LaserTAB: More efficient and precise contacts thanks to human-robot collaboration

and failure. Also, the bleeding led to increased levels of potassium in the blood, which was one of factors leading to heart failure.

The team was able to prevent gut failure by suppressing inflammation in the brain or blocking nerve pathways from the brain to the gut. The results suggest that tiny areas of inflammation around some specific vessels in the brain, which are known to happen in various brain diseases including multiple sclerosis, are a risk factor for organ dysfunctions including severe gut and heart failure.

"These results demonstrate a direct link between brain micro-inflammation and fatal gastrointestinal diseases via the establishment of a new neural pathway under stress," says Masaaki Murakami. "Micro-inflammation in the brain is also seen in Alzheimer's disease and Parkinson's disease. So it's of particular interest to investigate possible connections between brain micro-inflammations and organ dysfunctions, including those within the brain itself, in those patients."

The study was published in the journal *eLife*.

Media Contact

Naoki Namba
81-117-062-185

@hokkaido_uni

https://www.global.hokudai.ac.jp/

Naoki Namba | EurekAlert!

Further reports about: > CD4+ T cells > Hokkaido > T cells > blood vessels > inflammation > mouse models > neural circuit

More articles from Health and Medicine:

MRI contrast agent locates and distinguishes aggressive from slow-growing breast cancer
25.09.2017 | Case Western Reserve University

Investigators may unlock mystery of how staph cells dodge the body's immune system
22.09.2017 | Cedars-Sinai Medical Center

All articles from Health and Medicine >>>

The most recent press releases about innovation >>>

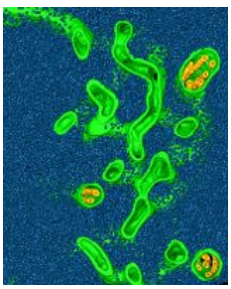
Die letzten 5 Focus-News des innovations-reports im Überblick:

Im Focus: LaserTAB: More efficient and precise contacts thanks to human-robot collaboration

At the productronica trade fair in Munich this November, the Fraunhofer Institute for Laser Technology ILT will be presenting Laser-Based Tape-Automated Bonding, LaserTAB for short. The experts from Aachen will be demonstrating how new battery cells and power electronics can be micro-welded more efficiently and precisely than ever before thanks to new optics and robot support.

Fraunhofer ILT from Aachen relies on a clever combination of robotics and a laser scanner with new optics as well as process monitoring, which it has developed...

Im Focus: The pyrenoid is a carbon-fixing liquid droplet



Plants and algae use the enzyme Rubisco to fix carbon dioxide, removing it from the atmosphere and converting it into biomass. Algae have figured out a way to increase the efficiency of carbon fixation. They gather most of their Rubisco into a ball-shaped microcompartment called the pyrenoid, which they flood with a high local concentration of carbon dioxide. A team of scientists at Princeton University, the Carnegie Institution for Science, Stanford University and the Max Plank Institute of Biochemistry have unravelled the mysteries of how the pyrenoid is assembled. These insights can help to engineer crops that remove more carbon dioxide from the atmosphere while producing more food.

A warming planet

25.09.2017 | Trade Fair News

Highest-energy cosmic rays have extragalactic origin
25.09.2017 | Physics and Astronomy

VideoLinks

Infrared emitters for the automotive industry
Re-activating of adhesives on automotive glass

The incredible power of light!
Light is more than you can see.

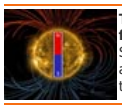
NASA | A Year in the Life of Earth's CO2
NASA Computer Model Provides a New Portrait of Carbon Dioxide

Black Holes Come to the Big Screen
The new movie "Interstellar" explores a longstanding fascination, but UA astrophysicists are using cutting-edge technology to go one better.

NASA's Swift Mission Observes Mega Flares from a Mini Star
NASA's Swift satellite detected the strongest, hottest, and longest-lasting sequence of stellar flares ever seen from a nearby red dwarf star.

NASA | Global Hawks Soar into Storms
NASA's airborne Hurricane and Severe Storm Sentinel or HS3 mission, will revisit the Atlantic Ocean for the third year in a row.

Baffin Island - Disappearing ice caps
Giff Miller, geologist and paleoclima-tologist, is walking the margins of melting glaciers on Baffin Island, Nunavut, Canada.

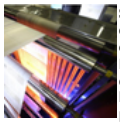


The sun's magnetic field is about to flip
Something big is about to happen on the sun.

The Infrasound Network and how it works
The CTBTO uses infrasound stations to monitor the Earth mainly for atmospheric explosions.

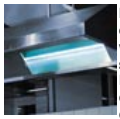
CU-Boulder team develops swarm of pingpong ball-sized robots

B2B-VideoLinks

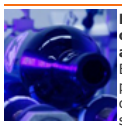


Special emitters for optimal energy efficiency
Heraeus special emitters promote both: energy production and energy saving

Gascatalytical infrared heat ...
... can save time, space and money by drying coatings with infrared heat



Efficient reduction of odour and grease with Heraeus UV solutions
Kitchen exhaust air cleaning with UV in gastronomy



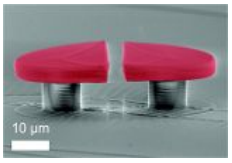
Drying and curing of paints on glass and ceramics
Bright and brilliant paints on glass and ceramics require safe solutions for drying and curing.

Im Focus: Highly precise wiring in the Cerebral Cortex

Our brains house extremely complex neuronal circuits, whose detailed structures are still largely unknown. This is especially true for the so-called cerebral cortex of mammals, where among other things vision, thoughts or spatial orientation are being computed. Here the rules by which nerve cells are connected to each other are only partly understood. A team of scientists around Moritz Helmstaedter at the Frankfiurt Max Planck Institute for Brain Research and Helene Schmidt (Humboldt University in Berlin) have now discovered a surprisingly precise nerve cell connectivity pattern in the part of the cerebral cortex that is responsible for orienting the individual animal or human in space.

The researchers report online in Nature (Schmidt et al., 2017. Axonal synapse sorting in medial entorhinal cortex, DOI: 10.1038/nature24005) that synapses in...

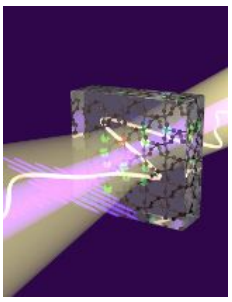
Im Focus: Tiny lasers from a gallery of whispers



New technique promises tunable laser devices

Whispering gallery mode (WGM) resonators are used to make tiny micro-lasers, sensors, switches, routers and other devices. These tiny structures rely on a...

Im Focus: Ultrafast snapshots of relaxing electrons in solids



Using ultrafast flashes of laser and x-ray radiation, scientists at the Max Planck Institute of Quantum Optics (Garching, Germany) took snapshots of the briefest electron motion inside a solid material to date. The electron motion lasted only 750 billionths of the billionth of a second before it fainted, setting a new record of human capability to capture ultrafast processes inside solids!

When x-rays shine onto solid materials or large molecules, an electron is pushed away from its original place near the nucleus of the atom, leaving a hole...

All Focus news of the innovation-report >>>

Top Send this article Print