

PeriCam PSI – noninvasive perfusion imaging

Facilitating data collection and analysis



Noninvasive perfusion imaging — PeriCam PSI

PeriCam PSI uses laser speckle contrast imaging (LSCI) and includes several key components that enable detailed and precise assessment of tissue blood perfusion at the microcirculation level, including a:



Positioning laser that creates visible crosshairs on the measurement site.



Near-infrared (NIR) laser that creates a speckle pattern on the tissue.



Precision imaging camera to record the subtle changes in the local contrast between speckles.



Documentation camera to take ordinary color images of the measurement area, useful for sharing and post-recording analysis.

Cleared* for use in clinical and research settings, PeriCam PSI is a non-contact, noninvasive, real-time perfusion imaging solution.

PeriCam PSI models

To deliver robust data for diverse research and clinical settings, we designed two PeriCam PSI models — HR and NR.

PeriCam PSI HR (high resolution) works from a fixed distance and is specifically equipped to measure small animals such as rats and mice.

For environments that demand versatility, **PeriCam PSI NR** supports a range of working distances.

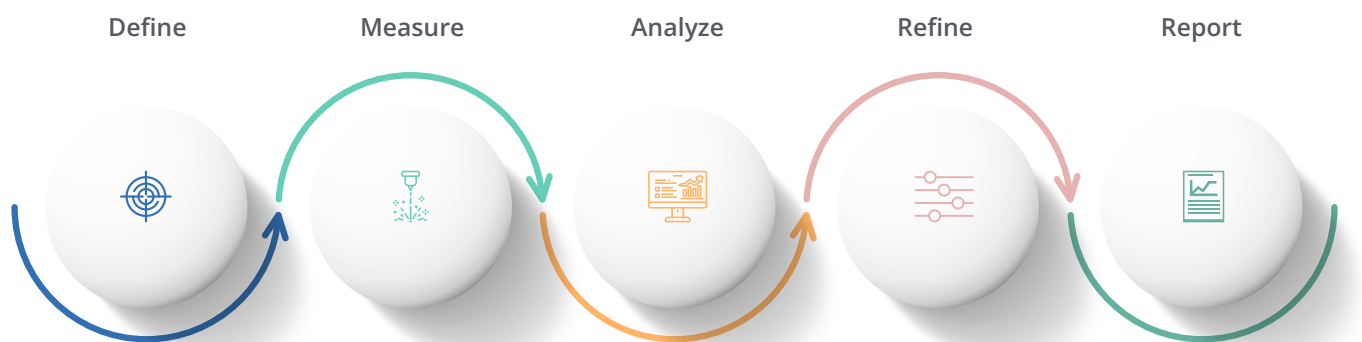
Both models can be upgraded with zoom functionality, combining high resolution and flexibility in a single instrument.

*PeriCam PSI is cleared for clinical and research use in certain regions, for more information, contact your local sales representative: <https://www.perimed-instruments.com/contact/>



Technical specifications

	HR	NR	HR/NR with zoom
Working distance	13 cm	13-41.5 cm	13-41.5 cm
Max area	21 x 25 mm	20 x 24 cm	20 x 24 cm
Max resolution	10 µm/pixel	33 µm/pixel	10 µm/pixel



Facilitating data collection and analysis

In all areas of research, capturing meaningful data, analyzing it, and rapidly interpreting it, can be challenging — especially when measuring highly dynamic biological processes. We designed PeriCam PSI to help overcome these challenges.

Some imaging techniques require contact with the tissue or contrast agents, which can disrupt natural physiology and compromise data integrity. PeriCam PSI is noninvasive and doesn't require agents, providing clear insights into blood flow dynamics without physically affecting the tissue.

PeriCam PSI can visualize even the finest blood flow dynamics, delivering continuous real-time data to help track dynamic processes such as neurovascular coupling or the sudden influx of blood flow following ischemia that occurs in stroke, heart attack, and revascularization surgery.

Our perfusion imager records these processes at a frequency of up to 100 images per second, capturing events at the necessary levels of detail — spatially and temporally.

Physiological factors like breathing, movement, or pulsation and external factors, such as vibration or ambient light fluctuation, can introduce artifacts into the data if they are not accounted for. To help prevent movement artifacts, we deliver PeriCam PSI with a high-quality arm. The instrument's automated background compensation capability ensures robust measurements under varying lighting conditions.



Neovascularization and angiogenesis

Because neovascularization and angiogenesis are essential for healing, we have quantified these processes to provide data for testing and development of effective new treatments — especially in fields like tissue engineering, regenerative medicine, wound healing, and cancer research.

By leveraging neovascularization data generated by PeriCam PSI, you can assess the effect of therapeutic agents that promote or inhibit angiogenesis on specific tissues.

Tumor growth and metastasis depend on the ability of cancer cells to induce angiogenesis, and so inhibiting it is a target for therapies. The data

PeriCam PSI generates shows the effectiveness of this kind of prevention technique.

Diabetes is often associated with impaired wound healing due to compromised blood flow. Neovascularization data can help researchers validate novel ways to enhance the formation of new blood vessels in diabetic ulcers.

For these kinds of scenarios, PeriCam PSI delivers the necessary data about new vessel formation in a noninvasive and non-destructive way. The robust measurement technique of the instrument supports longitudinal studies by enabling researchers to track changes in microvascular blood perfusion over time.

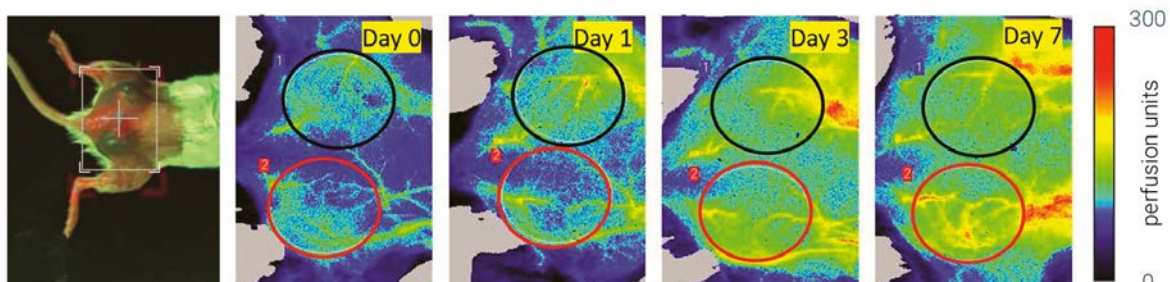
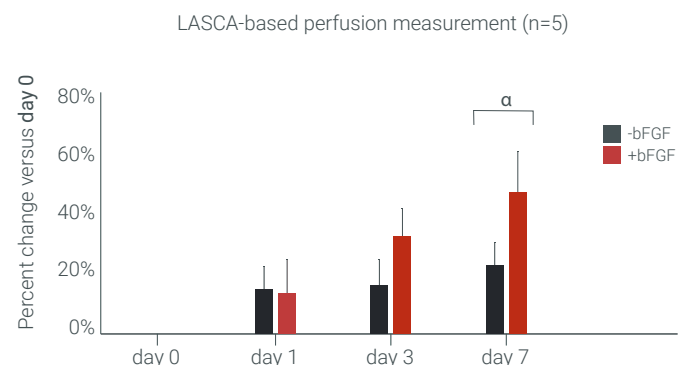


Figure 1: Dorsal PeriCam PSI perfusion images of a mouse with two subcutaneous fibrin scaffold implants — one with and one without angiogenic growth factor. The ROIs were chosen based on the physical location of the implants.

Figure 2: Change in perfusion relative to day 0, based on an ROI analysis of the PSI perfusion images, shows an overall increase over time. The greatest change in perfusion was observed on day 7, with +bFGF scaffolds trending toward greater perfusion than -bFGF scaffolds [1][2].

Figures courtesy of Dr. Mario Fabiilli from LED-Based Photoacoustic Imaging for Monitoring Angiogenesis in Fibrin Scaffolds [1].



Murine hind limb ischemia

HLI is an important model for studying PAD and developing new therapies for it. Following surgically induced acute limb ischemia, vascular regeneration, angiogenesis, and arteriogenesis can be assessed.

The model can be used to evaluate pro-angiogenic effects of therapeutic agents [3] or natural recovery in healthy [4] compared with diseased (diabetic) [5][6][7] young vs. aged [8],

and wild-type contra knockout animals [9][10] [11].

Post-surgery, PeriCam PSI provides researchers with the data to confirm ischemia — a decrease in blood perfusion in the microcirculation of about 60-70%.

Longitudinally, PeriCam PSI can deliver the data to validate the efficacy of a treatment strategy.



Figure 3: Hind limb ischemia (HLI) surgery was performed in mice and real-time microcirculation imaging was analyzed using a PeriCam perfusion speckle imager (PSI, Perimed). Provided by Dr. Yi Tan, Pediatric Research Institute, University of Louisville School of Medicine. References: *Circulation Research*. 2017;120:e7-e23; *Diabetes* 2020;69:1779–1792.

Cutaneous wound healing

To support the metabolic needs of tissue repair during wound healing, the formation of angiogenic capillaries and their organization into microvascular networks is essential. Diseases like diabetes disrupt this process, leading to wound-healing impairment. Owing to the global prevalence of this issue, the development of materials and therapeutics to promote wound healing is a major area of research.

To assess new therapies, researchers often use a cutaneous wound-healing model where subjects are measured at various intervals during the two-week healing process following the creation of a wound.

Typically, researchers look for a reduction in wound size and mature vasculature formation using CD31 and α -SMA immunohistochemistry. However, this approach involves euthanizing the animals at each measurement.

PeriCam PSI can measure blood perfusion in wounds over the entire two-week healing period on the same animal, reducing the number of subjects needed and supporting robust findings.

The data can be used to evaluate pro-angiogenic effects of therapeutic agents or natural recovery in healthy compared with diseased (diabetic) and wild-type vs knockout animals [12][13][14][15].

CAM assay

The CAM assay is a versatile model for studying tumor formation, angiogenesis, and metastasis.

The model relies on the creation of a window in the shell of a fertilized chicken egg, enabling researchers to observe the embryo and the formation of blood vessels.

PeriCam PSI, enables you to measure the change in blood perfusion in the angiogenesis assay and assess the efficacy of different pro-angiogenic compounds. You can monitor the formation of functional intratumoral blood vessels [16] and validate the effectiveness of anti-angiogenic agents for cancer treatment.

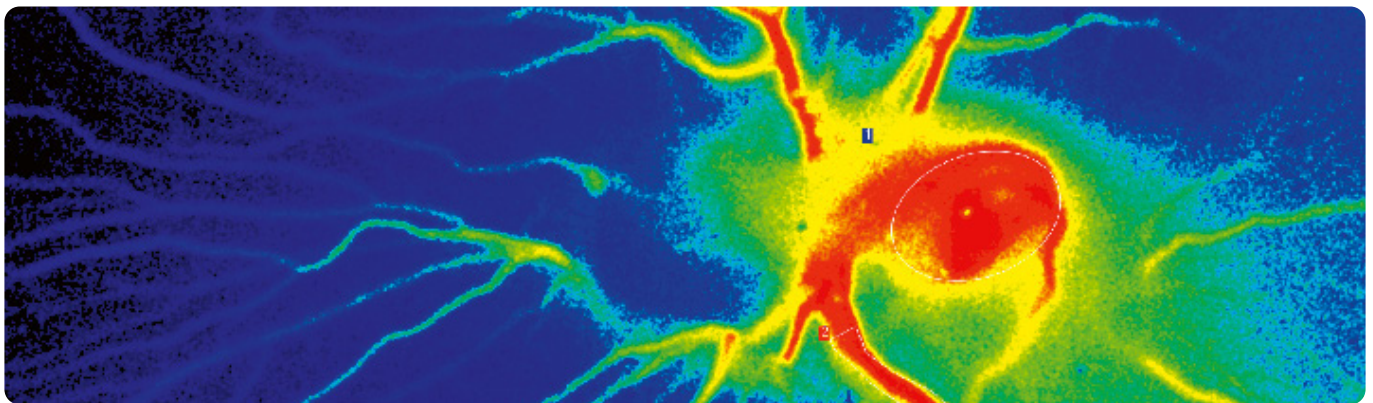


Figure 4: PeriCam PSI perfusion image of CAM assay 6 days after fertilization

Subcutaneous tumor

The growth and metastasis of cancer tumors rely on the development of blood vessels and an effective microcirculation. Without angiogenesis, tumor cells cannot grow at a secondary site. The central role angiogenesis plays in tumor growth, progression, invasion, and metastasis, inhibiting it is a potential treatment strategy.

The subcutaneous tumor model is a popular in vivo system for assessing medicine candidates.

The model often uses immunodeficient animal strains, where cultured cancer cells are implanted subcutaneously, producing a solid tumor in about two weeks.

PeriCam PSI measures and visualizes blood perfusion in subcutaneous tumors over time, helping you to monitor tumor progression and validate the efficacy of anti-angiogenic therapies.

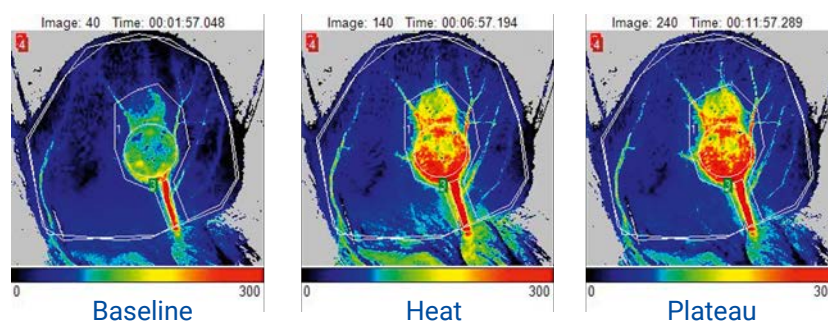


Figure 5: Perfusion images of mouse ear with subcutaneous tumor at day 14. Images reflect an increase in tumor blood perfusion in response to a heat challenge.

Cerebral blood flow

Cerebral blood flow (CBF) is a key biomarker in neuroscience, offering insight into various brain functions and neurological conditions.

The spatial resolution, field of view, and frame rate of PeriCam PSI ensure it can deliver quality brain images, helping researchers to capture and analyze minute changes in CBF.

The noninvasive nature of the underlying technology — laser speckle contrast imaging (LSCI) — ensures that PeriCam PSI can measure and visualize perfusion in real-time without

influencing the tissue through contact, or the use of contrast dyes and tracer elements.

Stroke

The middle cerebral artery occlusion (MCAO) model is a popular research method that involves restricting blood flow to induce ischemic stroke.

Figure 6 illustrates how PeriCam PSI captures cerebral blood flow, before and after induction, helping you to assess the efficacy of treatment.

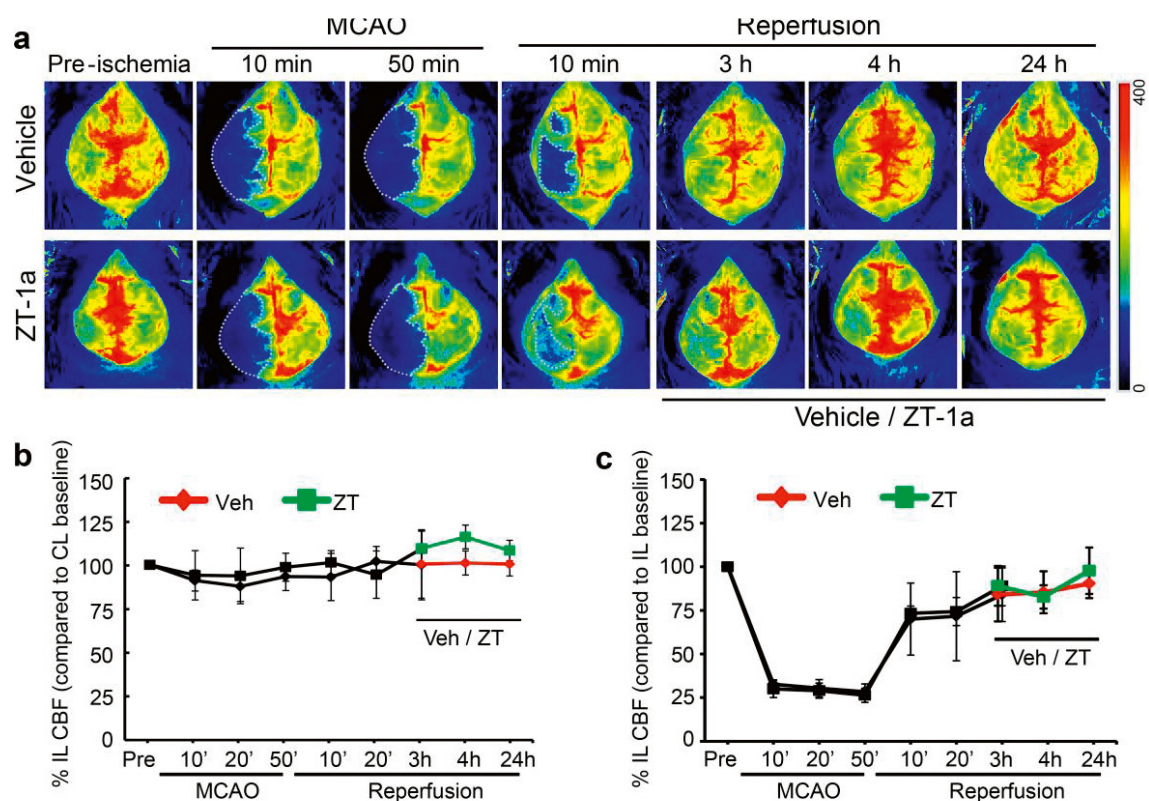


Figure 6: Perfusion images and quantified perfusion data generated by PeriCam PSI for the ipsilateral and contralateral sides of a mouse brain before and after MCAO for a treated and untreated animal.

Neurovascular coupling

Neurovascular coupling (NVC) and the process of functional hyperemia regulate and control cerebral blood flow to match the brain's metabolic demands.

Advances in high-resolution imaging have enabled researchers to study hyperemia in real time helping neuroscientists to better understand the roles of

neurons, astrocytes, and endothelial cells, and their impact on aging and neurodegenerative diseases.

Figure 7 shows how PeriCam PSI visualizes the hemodynamic changes in the somatosensory cortex of a mouse brain, in response to a 30-second electrical stimulation of the animal's whiskers [17][18][19][20] — carried out by Sébastien Foulquier at Maastricht University, The Netherlands.

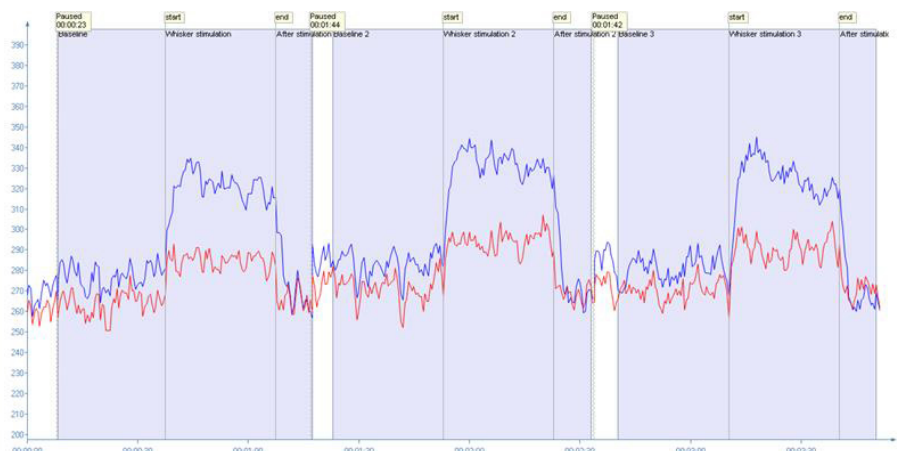
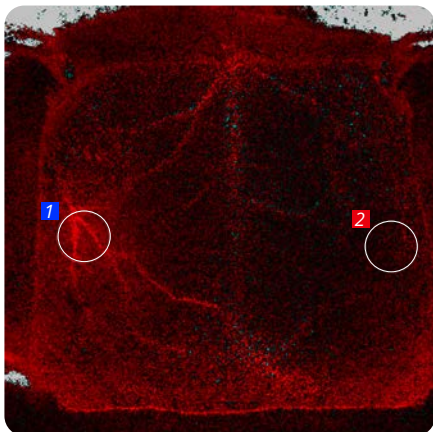
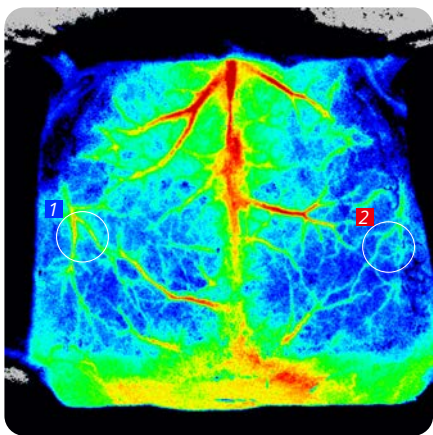
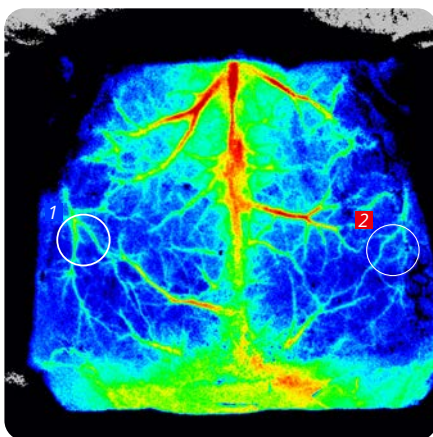


Figure 7: Cerebral blood flow (CBF) is recorded at baseline and assessed by stimulating right whiskers for 30 seconds at a frequency of 5 Hz. PeriCam PSI captures the entire cerebral cortex and measures the change in CBF over the barrel cortex using two regions of interests: on the left side (stimulated side) and on the right side (control, non-stimulated side). The stimulation is repeated three times with 2-minute resting periods in between.

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PeriCam PSI has helped us to study changes in cerebral blood flow in different rodent models, from mice to rats. We are always pleased by the imaging quality, ease of use, and user-friendly software interface.

—Sébastien Foulquier, Pharm.D., Ph.D.

Traumatic brain injury

Real-time cerebral blood flow (CBF) monitoring is essential in TBI research, as disruptions in blood supply can exacerbate brain damage.

PeriCam PSI is a powerful solution for capturing CBF across the entire mouse brain without disrupting delicate tissue.

With high-resolution imaging, it visualizes even the smallest changes in microcirculation, allowing you to:

- Study small subjects like mice with precision.
- Assess the extent of ischemic injury and its impact on brain tissue.
- Evaluate the effectiveness of therapeutic interventions.

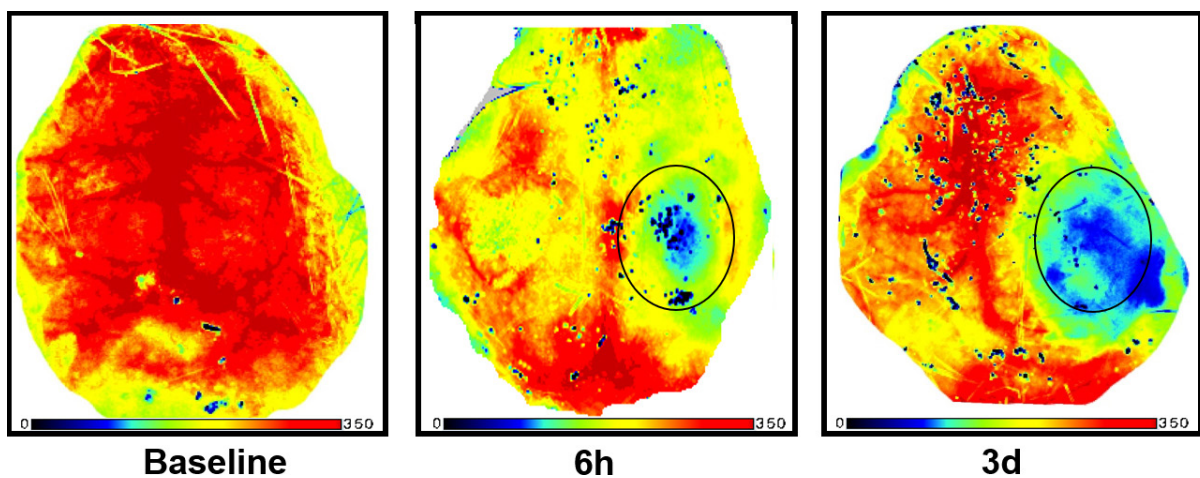


Figure 8: PeriCam PSI images show the full mouse brain, visualizing the response to a TBI before, at 6 hours, and 3 days after the injury. Courtesy of Dr. Han Liu Department of Neurosurgery, the First Affiliated Hospital of Chongqing Medical University, China [24].

Cortical spreading depolarization

Cortical spreading depolarization (CSD) refers to waves of rapid, near-complete disruption of ion balances across nerve cell membranes that occur after trauma and result in cytotoxic edema.

Depolarization waves propagate at about 3 mm per minute within cerebral gray matter, contributing to the development of spreading ischemia — which plays a critical role in neurodegeneration following acute brain injury.

Figure 9 shows how PeriCam PSI captures the changes in perfusion at 30-second intervals following the application of a highly concentrated potassium solution [21][22][23][24].

The top row of images reflect absolute perfusion values. The second row illustrates the difference. In the initial 30 seconds, increased perfusion (red) is visible at the trauma site. In the minutes that follow, spreading depolarization is clearly visible as the areas of decreasing perfusion (cyan) grow.

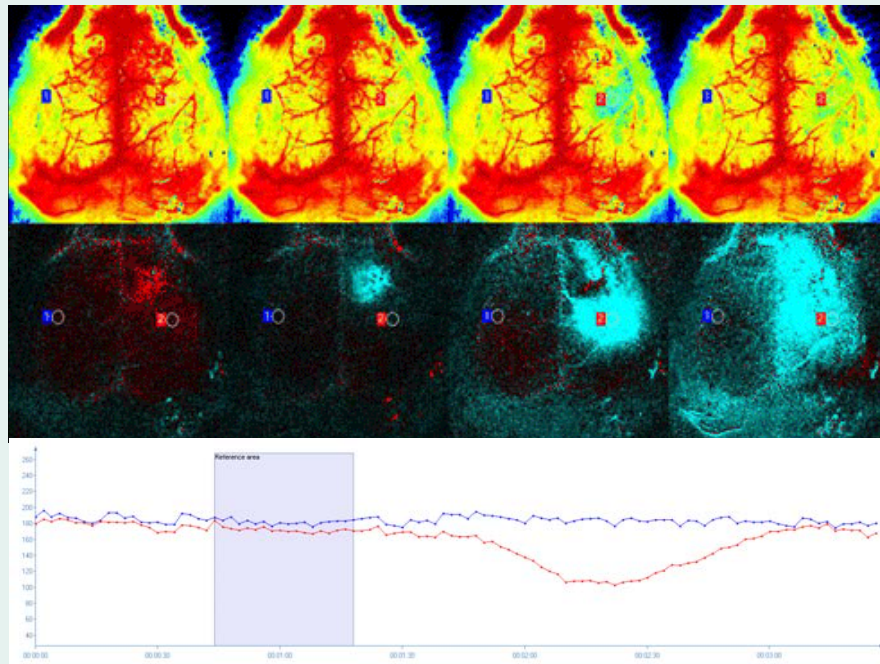


Figure 9: Courtesy of Charité, Berlin, Germany using PeriCam PSI HR.

Chronic cerebral hypoperfusion

Studies of chronic cerebral hypoperfusion are critical for understanding vascular dementia and assessing the long-term effects of reduced blood flow to the brain, stroke, and cardiovascular diseases.

Mouse models enable researchers to investigate the mechanisms of hypoperfusion, characterize the progression of brain damage, identify biomarkers, and evaluate the efficacy of drugs and other interventions.

Figure 10 shows how PeriCam PSI captures perfusion in a mouse brain before and after injury using the bilateral common carotid artery occlusion (BCCAO) model. Treated and untreated animals were followed for 28 days.

The data and images indicate that the 28-day perfusion levels in treated animals are approaching pre-injury levels.

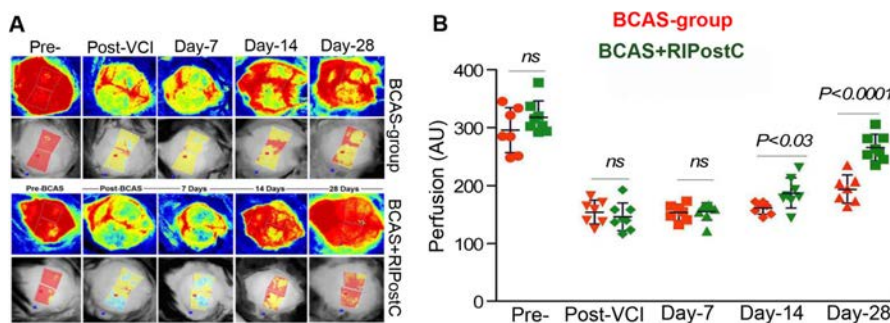


Figure 10: Courtesy of Dr. Nasrul Hoda Georgia Regents University, University of Georgia, and Charlie Norwood VA Medical Center, Augusta, GA. Reproduced with permission of Translational Stroke Research and originally published in [25].

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About Perimed

With over 40 years of experience and unique competence in measuring blood perfusion with laser-based technologies, Perimed is a leader in medical solutions that generate insights to aid peripheral vascular diagnosis. We have over 4,000 installed instruments worldwide, operating in wound care departments, diabetic foot clinics, vascular centers, labs, and radiology — saving limbs, saving lives, and reducing human suffering.



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All specifications are subject to change without notice.

