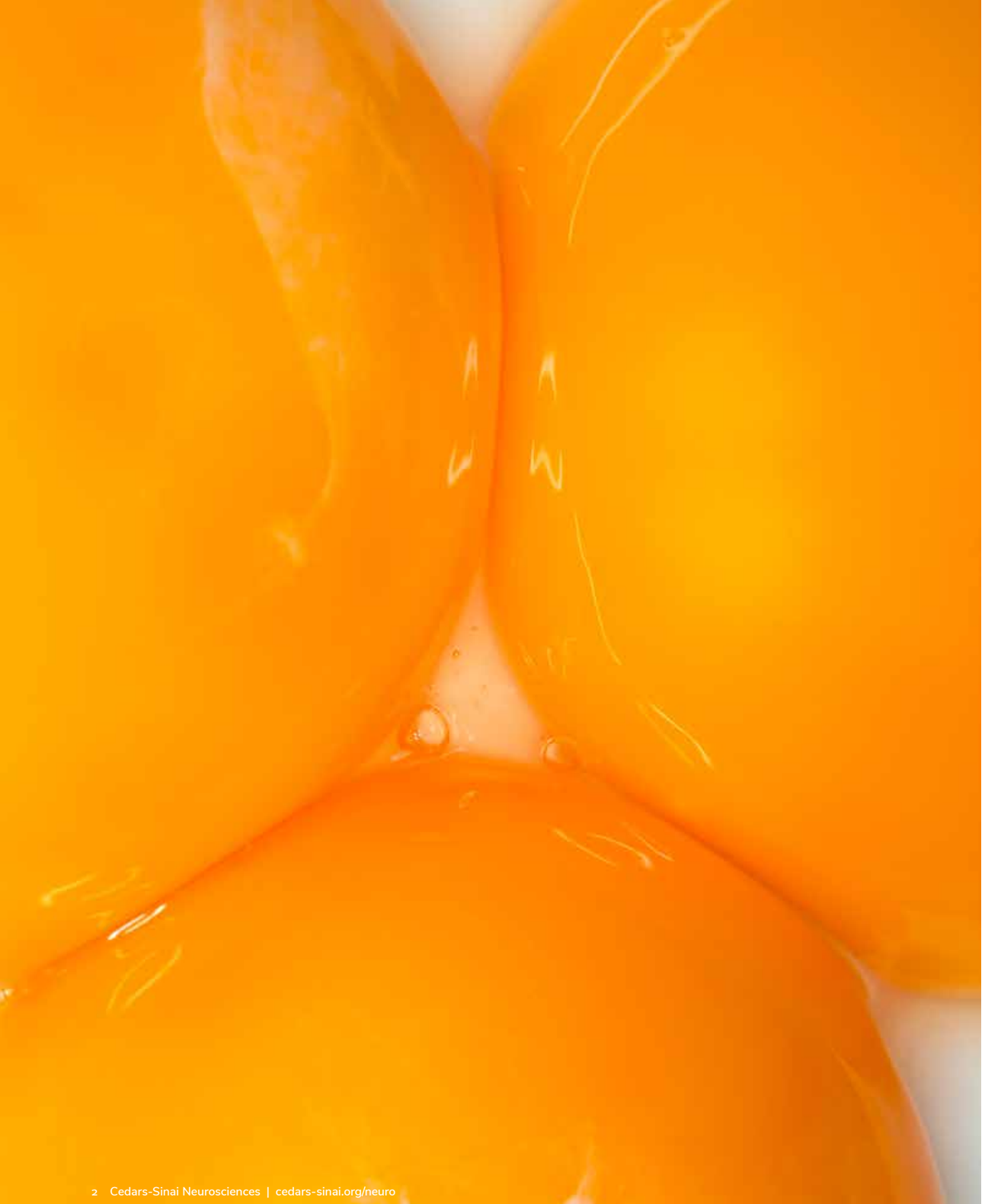
2021 NEUROSCIENCES ANNUAL REPORT

NEURO

Cedars Sinai

The images in this report feature photography of foods rich in healthful nutrients like omega-3 fatty acids, B vitamins and antioxidants, which are known to support brain health and cognitive function. They are: purple sweet potato (cover), eggs (p. 2), blueberries (p. 6), tomatoes (p. 9), kale (p. 10), cumin (p. 13), green tea (p. 14), walnuts (p. 17), cauliflower (p. 18), grapes (p. 21), turmeric (p. 22), fish (p. 24) and orange (p. 32).



Dear Colleague,

We are pleased to share with you our annual report for the Cedars-Sinai Departments of Neurology & Neurosurgery. While the COVID-19 pandemic presented many challenges to caring for our patients, we have continued to make incredible strides in neuroscience research. We have expanded our understanding of the human brain and made significant progress in the diagnosis of neurological disorders, including Alzheimer's disease, brain tumors, neurovascular and functional disorders, cerebrospinal fluid (CSF) leak and multiple sclerosis (MS).

We established the Jona Goldrich Center for Alzheimer's and Memory Disorders in 2019 to fund research for Alzheimer's and develop a comprehensive care model for a rapidly growing population at risk for dementia. 2020 marked the inauguration of our Neuroimaging Program, a multidisciplinary effort that will foster work across subspecialties to refine the diagnosis of complex and hard-to-detect neurological diseases, utilizing cutting-edge technology to identify these conditions sooner and with better accuracy.

We continue to care for our patients during the COVID-19 pandemic and remain committed to growing and advancing our programs for neurological disorders, exploring basic and translational research, and improving patient outcomes. Our expert teams during this time have been able to provide a high level of care to our patients with neurological disorders, increase access to services throughout Los Angeles County and implement protocols that have enabled us to deliver treatment more quickly to patients who need it most—like our ischemic stroke patients. This effort has resulted in Cedars-Sinai having the lowest mortality rate in the U.S. for ischemic strokes among Medicare patients.

This annual report highlights some of the achievements we've made—from groundbreaking research to launching new programs—and the ways we're working to forge ahead into the future as innovators in the field.

Keith L. Black, MD
Chair, Department of Neurosurgery
Ruth and Lawrence Harvey
Chair in Neuroscience

Nancy L. Sicotte, MD, FAAN
Chair, Department of Neurology
Women's Guild Distinguished
Chair in Neurology

2020 HIGHLIGHTS

NEUROSCIENCES AT A GLANCE

8.7%

Cedars-Sinai's Comprehensive Stroke Center has the lowest mortality rate in the U.S., at 8.7%, for ischemic strokes among Medicare patients, according to new data from the Centers for Medicare & Medicaid Services

No. 10

in the nation as ranked by *U.S. News & World Report*

No. 1

in Los Angeles County for inpatient neurosciences discharges

NOTABLE DEVELOPMENTS

Following an extensive national search, Zaldy Tan, MD, MPH, has been named medical director of the **Jona Goldrich Center for Alzheimer's and Memory Disorders**, which will drive discovery science and provide access to novel therapeutics. He is also the Carmen and Louis Warschaw Chair in Neurology and director of the Memory and Aging Program, a multidisciplinary care management system to serve patients and their families in the Cedars-Sinai Health System who are coping with dementia.

This innovative program will include experts from geriatrics, psychiatry, genetics, social work and neuropsychology to provide individualized assessment, care plans and community resources (see page 7).

A Cedars-Sinai research team conducted the first study to reveal the **retinal molecular and cellular mechanisms of vascular degeneration** important for blood flow and toxic amyloid-beta removal as critical components of cognitive function. The paper, published in *Acta Neuropathologica*, shows that deficiency in vascular PDGFRβ is closely associated with increased brain levels of amyloid-beta buildup, including on the walls of brain arteries, and loss of cognitive function.

The retinal abnormalities detected in the new study also were found in patients with mild cognitive impairment. Taken together, these findings offer significant insights into how Alzheimer's develops, with major clinical implications.

The Ray Charles Foundation invested in future leaders for the field, donating $1 million to fund a new neurosurgery scholarship program at Cedars-Sinai. **The Ray Charles Foundation Scholars Fund in Neurosurgery** aims to enhance diversity in the neurosciences by supporting the training of students who come from underrepresented backgrounds, with a focus on historically Black colleges and universities.

The scholarship program will accept one or two MD or PhD students to participate every year. Under the direction of Keith L. Black, MD, chair of the Cedars-Sinai Department of Neurosurgery and the Ruth and Lawrence Harvey Chair in Neuroscience, scholarship recipients will be matched with a principal investigator who will provide mentorship, guidance and career-development advice. Scholars also will be able to access the day-to-day resources and training they need to pursue their own research.

2019 marked the 21st year of **Brainworks**, an initiative created by Keith L. Black, MD, that is focused on exposing students from Los Angeles-area schools to careers in neuroscience. Since its inception, Brainworks has helped do that for more than 3,000 young Angelenos through a daylong program that uses hands-on exhibits.

In February 2020, Cedars-Sinai held the **third annual Intracranial Hypotension Symposium** in partnership with the Spinal CSF Leak Foundation. Faculty members from U.S. and international institutions—including Johns Hopkins, Duke University Medical Center, Mayo Clinic and University of Toronto—participated.

In addition to providing a place where specialists from around the world can collaborate and share findings, the symposium has resulted in many physicians, neurologists and neurosurgeons visiting Cedars-Sinai to shadow Wouter Schievink, MD, director of the Microvascular Neurosurgery Program, in an effort to gain insights directly from one of the world's premier CSF leak experts.

A multidisciplinary team of scientists led by Cedars-Sinai was recently awarded an **$8 million BRAIN Initiative grant** to further study how human neurons act in the formation and recall of memories. This research will investigate how neurons from distinct brain areas are activated to make memory-based decisions, how the beginning and end of an event are detected, and how the firing patterns of these nerve cells work to initiate the formation of a new memory. The project will also investigate how electrical stimulation of these same brain areas can be used to improve memory. The research team includes investigators from Boston Children's Hospital, Harvard Medical School in Boston; Johns Hopkins University in Baltimore; the University Health Network in Toronto; the University of Colorado, Denver; the University of California, Santa Barbara; and the California Institute of Technology in Pasadena, California.

Keith L. Black, MD, will join a number of other luminaries across a range of fields and disciplines on California's new **Alzheimer's Prevention and Preparedness Task Force.** The group is charged with devising a plan for addressing and managing Alzheimer's and other aging-related conditions throughout the state.

ALZHEIMER'S DISEASE AND MEMORY DISORDERS

The new Jona Goldrich Center for Alzheimer's and Memory Disorders is paving the way for a revolution in how we treat dementia and its associated decline in cognitive function.

Zaldy Tan, MD, MPH
Medical Director, Jona Goldrich Center for Alzheimer's and Memory Disorders, Carmen and Louis Warschaw Endowed Chair in Neurology, Acting Professor of Neurology

In 2019, the Goldrich family partnered with Cedars-Sinai to make a visionary commitment to reshape the landscape of Alzheimer's disease care and establish the Jona Goldrich Center for Alzheimer's and Memory Disorders.

RESEARCH SPOTLIGHTS

RESEARCH ADVANCES IN MEMORY DISORDERS

Altered immune cells may potentially be used to help preserve cognition in Alzheimer's patients, according to new research published in the journal *Brain*. The study's lead author, Maya Koronyo-Hamaoui, PhD, a research scientist at the Maxine Dunitz Neurosurgical Institute and associate professor of Neurosurgery and Biomedical Sciences, and her team genetically modified and administered monocytes to animal models that exhibit features of Alzheimer's. These modified immune cells effectively targeted and destroyed protein fragments associated with the disease.

The study also showed that the enhanced monocytes reduce inflammation in the brain and secrete more insulin-like growth factor 1, a substance important for survival of neurons and production of new synapses between them.

EFFECTS OF SHORT-TERM MECHANICAL VENTILATION ON NEUROPATHOLOGY IN ALZHEIMER'S DISEASE

Investigators in the Cedars-Sinai Department of Neurology tested the theory that short-term mechanical ventilation contributes to the neuropathology of cognitive impairment.

Published in *Critical Care*, the data indicated that short-term mechanical ventilation promotes neuropathology characteristic of Alzheimer's by increasing cerebral soluble $A\beta_{1-40}$, promoting neuroinflammation and altering blood-brain barrier permeability.

Led by first author and Cedars-Sinai neurologist Shouri Lahiri, MD, these findings could help mitigate the risk of cognitive decline after critical illness, particularly among older individuals with preexisting cognitive impairment, by facilitating development of neuroprotective, short-term, mechanical-ventilation strategies.

4,000

Every year, approximately 4,000 patients with Alzheimer's disease or related dementias receive medical care at Cedars-Sinai.

BRAIN TUMORS

The pioneering therapies and technologies that neurosurgeons at Cedars-Sinai use to diagnose and treat brain tumors have been decades in the making.

Keith L. Black, MD
Chair, Department of Neurosurgery, Director, Maxine Dunitz Neurosurgical Institute, Ruth and Lawrence Harvey Chair in Neuroscience, Professor, Neurosurgery

Cedars-Sinai is one of the highest-volume brain tumor centers in the U.S. Our team of five neurosurgeons, all of whom subspecialize in a range of brain tumors and perform hundreds of brain surgeries every year, is hard at work developing novel approaches to diagnosis and treatment.

RESEARCH SPOTLIGHT

Starting in 1997, when our neuroscientists began translating dendritic cell vaccines from preclinical models to clinical models, Cedars-Sinai has led the way in providing innovative clinical trials for malignant brain tumors.

"The clinical outcomes of our brain tumor patients continue to push us forward," Keith L. Black, MD, says. "Our dendritic cell vaccine to treat glioblastoma was studied in a Phase III clinical trial involving patients at more than 120 medical centers worldwide."

Several patients who were in the Phase I trial are living past 10 years—a remarkable achievement for advancing the treatment of glioblastoma, in which only 3% of diagnosed patients live five years or longer.

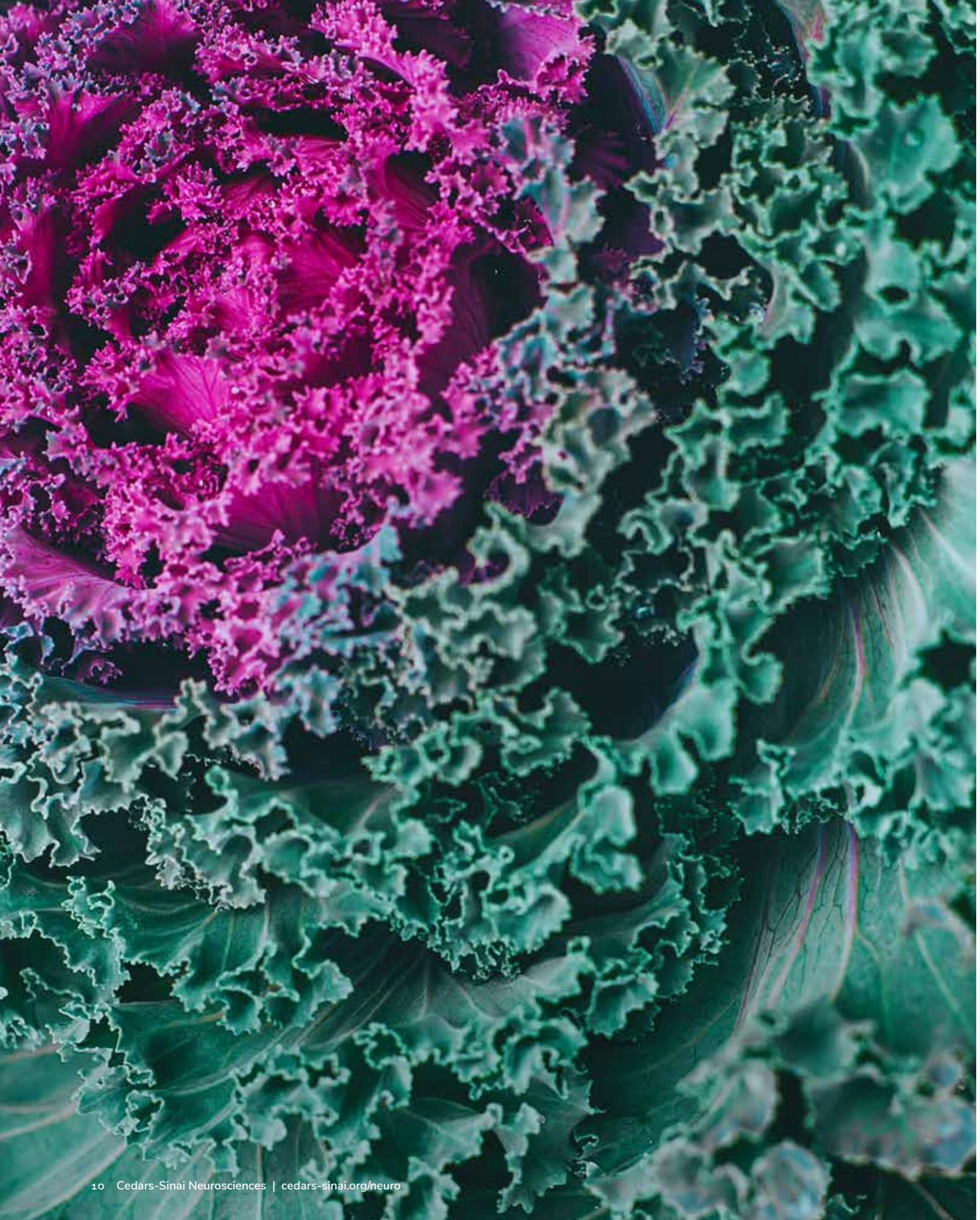
TECHNOLOGY

Cedars-Sinai was one of the first hospitals in Southern California to employ the use of Synaptive Medical's BrightMatter technology, which is now used in about one-third of brain surgeries performed in the Department of Neurosurgery.

We remain committed to offering our patients the most advanced technology available to diagnose and treat brain tumors, including thermal-laser ablation, focused ultrasound and intraoperative surgical planning using 3D navigation to map safe corridors within the brain and avoid eloquent areas.

24

In FY2020, the Cedars-Sinai Brain Tumor Center conducted 24 clinical studies and trials ranging from immunotherapy to targeted techniques.



CSF LEAK

The dedicated CSF Leak Program at Cedars-Sinai continues to advance the diagnosis and treatment of this often difficult-to-detect disorder.

Wouter Schievink, MD
Director, Cerebrospinal Fluid Leak, Director, Microvascular Neurosurgery Program, Professor, Neurosurgery

Our specialized team uses advanced imaging techniques to provide the best information for treatment planning, including magnetic resonance myelography and digital subtraction myelography to identify the location of a suspected CSF leak.

RESEARCH SPOTLIGHT

FIRST TO DESCRIBE SPONTANEOUS SPINAL CSF-VENOUS FISTULAS

Over the past year, Wouter Schievink, MD, and his team have refined characteristics of spontaneous spinal CSF-venous fistulas, a distinct type of spinal CSF leak recently described in patients with spontaneous intracranial hypotension (SIH).

Using digital subtraction myelography (DSM) with the patient in the prone position, investigators were able to demonstrate the presence of such fistulas in about 15% of patients with SIH in whom conventional spinal imaging (MRI or CT myelography) showed no evidence of a CSF leak.

With a recent modification of the imaging protocol (DSM with patients in the lateral decubitus position versus the prone position), the detection rate of spinal CSF-venous fistulas in patients with SIH increased fivefold.

"In our study, we were able to increase the detection rate from 15% to 75% in these patients, which has been revolutionary in identifying and diagnosing this type of CSF leak," Schievink says. "Since we started using digital subtraction myelography a few years ago, we now have a really good idea of what the different types of CSF leaks are."

Schievink and his team were the first to identify the presence of soft-tissue venous/venolymphatic malformations associated with spontaneous spinal CSF-venous fistulas.

The association and proximity of these venous/venolymphatic vascular malformations with spontaneous spinal CSF-venous fistulas suggest that proximal pathology (e.g., structural dural weakness/meningeal diverticula) may be important in the pathogenesis of the fistulas, as well as distal pathology with abnormal venous anatomy.

2,000

We have treated more than 2,000 patients since 2000—50% from outside California, 26.5% from outside Los Angeles County, 6.3% from outside the U.S.

Number of new patients per year more than doubled between 2009 and 2019

Most highly cited article on CSF leak, JAMA

76 peer-reviewed publications on CSF leak

EPILEPSY

Neuroscientists at Cedars-Sinai are advancing the treatment of epilepsy through targeted research focusing on seizures and memory.

As a Level 4 epilepsy center, the highest level of accreditation from the National Association of Epilepsy Centers, the Epilepsy Program in the Department of Neurology at Cedars-Sinai is able to treat patients with even the most rare, complex or misdiagnosed medical cases related to the condition.

Jeffrey M. Chung, MD, FAAN, FAES
Director, Epilepsy Program, Director, Neurophysiology Laboratory, Associate Professor of Neurology

Lisa M. Bateman, MD, FRCPC
Director, Surgical Epilepsy Program for Cedars-Sinai Health System, Acting Professor of Neurology

RESEARCH SPOTLIGHT

GROUNDBREAKING STUDY OF COGNITIVE IMPAIRMENT AND MEMORY IN EPILEPSY

A Cedars-Sinai-led study that was the first to investigate transient cognitive impairment in epilepsy revealed how memory and abnormal brain activity are linked in patients with epilepsy who often report problems with memory. Senior author Ueli Rutishauser, PhD, associate professor in the Department of Neurosurgery and the Board of Governors Chair in Neurosciences, and his team investigated electrical activity in the hippocampus.

Published in *The Journal of Neuroscience*, the results called attention to the phenomenon of transient cognitive impairment, which researchers believe to be related to interictal epileptiform discharges (IEDs).

Epilepsy patients commonly experience IEDs between seizures and report transitive cognitive impairment. However, it has so far remained unknown why IEDs cause such impairment.

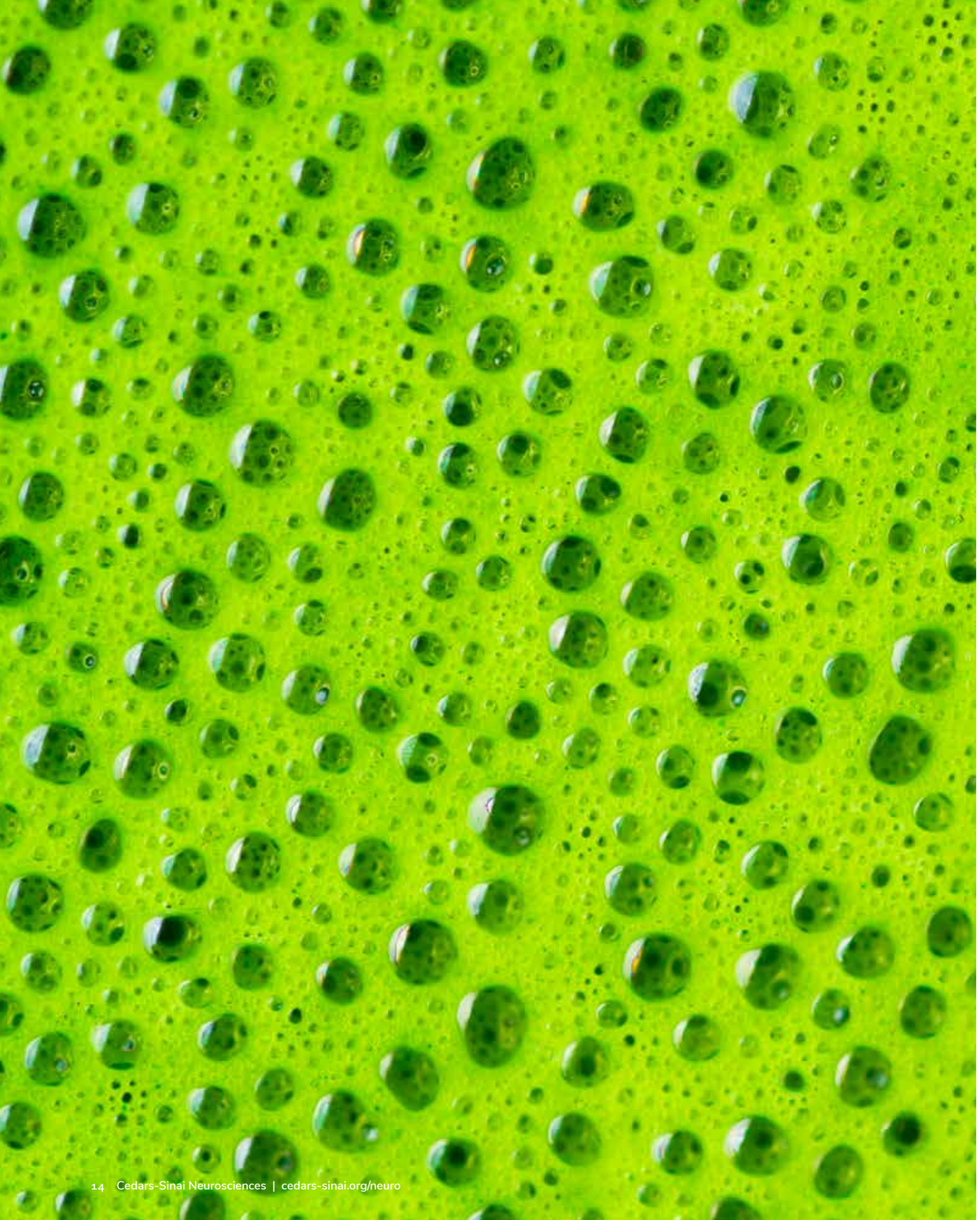
"The unpredictability of seizures and memory impairment is a major stressor in people who have epilepsy," says the study's first author, Chrystal Reed, MD, PhD, assistant professor of Neurology at Cedars-Sinai.

Understanding how and why memory impairments occur may help develop treatment options to improve quality of life for epilepsy patients.

1ST
to investigate transient cognitive impairment in epilepsy

CLINICAL SERVICES

- Designated inpatient Epilepsy Monitoring Unit
- Advanced diagnostic studies, including functional mapping; neuropsychological testing; MRI, PET and co-registration studies; magnetic source imaging of the epileptic activity of the brain; and ictal SPECT analysis
- Epilepsy Surgery Program offering state-of-the-art techniques to determine the precise brain regions from which seizures originate, along with individualized resective surgery and neuromodulation therapy options for patients in whom seizures are not controlled by conventional medical treatments



HUMAN BRAIN AND COGNITION RESEARCH

The laboratory of Ueli Rutishauser, PhD, is investigating the neural mechanisms of learning, memory and decision-making.

Ueli Rutishauser, PhD
Director, Human Neurophysiology Research, Board of Governors Chair in Neurosciences, Professor of Neurosurgery, Neurology and Biomedical Sciences

As part of a systems neuroscience laboratory, investigators use a combination of in vivo single-unit electrophysiology in humans, intracranial electrocorticography, eye tracking, and behavior and computational approaches. An overarching goal is to capitalize on special neurosurgical situations to advance knowledge of the human nervous system.

RESEARCH SPOTLIGHT

UNDERSTANDING HOW THE BRAIN RETRIEVES MEMORIES

Flexibly switching between different tasks is a fundamental human cognitive ability that allows us to make selective use of only the information needed for a given decision. Rutishauser and his team used single-neuron recordings from patients to understand how the human brain retrieves memories on demand when needed for making a decision and how retrieved memories are dynamically routed in the brain from the temporal to the frontal lobe. When memory was not needed, only medial frontal cortex neural activity was correlated with the task.

However, when outcome choices required memory retrieval, frontal cortex neurons were phase-locked to field potentials recorded in the medial temporal lobe. Therefore, depending on the demands of the task, neurons in different regions can flexibly engage and disengage their activity patterns.

This discovery may aid development of future treatments for memory disorders that accompany certain conditions, like schizophrenia and Alzheimer's disease.

$17M+
NIH funding in the next five years

Lead site for five-center BRAIN Initiative

15 peer-reviewed papers in the last two years in high-impact journals

MOVEMENT DISORDERS

The Cedars-Sinai Parkinson's Disease Center promotes the highest standards of care, innovative research and outreach services.

Michele Tagliati, MD
Director, Movement Disorders Program, Professor and Vice Chair, Neurology, Caron and Steven D. Broidy Chair in Movement Disorders

The center was the first to offer a multidisciplinary Parkinson's disease clinic in Southern California. Through collaboration across multiple research departments at Cedars-Sinai devoted to the study and treatment of movement disorders, the entire team is committed to finding potential new treatments and offering the latest clinical trials to our patients.

RESEARCH SPOTLIGHTS

STEM CELL STUDY FINDS PARKINSON'S MAY START BEFORE BIRTH

Cedars-Sinai researchers discovered that people who develop Parkinson's disease before age 50 may have been born with disordered brain cells that went undetected for decades.

Published in *Nature Medicine*, the study focused on young-onset patients between ages 21 and 50, who account for about 10% of Parkinson's diagnoses in the U.S. The research team generated induced pluripotent stem cells (iPSCs) from these young-onset patients, then used the iPSCs to produce dopamine neurons and analyze the neurons' functions. Through this analysis, two abnormalities were detected: accumulation of the alpha-synuclein protein (which occurs in most forms of Parkinson's) and malfunctioning lysosomes, which can cause alpha-synuclein to build up.

"Our technique gave us a window back in time to see how well the dopamine neurons might have functioned from the very start of a patient's life," says Clive Svendsen, PhD, the study's senior author. "What we are seeing using this new model are the very first signs of young-onset Parkinson's," adds Svendsen, who is director of the Cedars-Sinai Board of Governors Regenerative Medicine Institute and the Kerry and Simone Vickar Family Foundation Distinguished Chair in Regenerative Medicine.

"Young-onset Parkinson's is especially heartbreaking because it strikes people at the prime of life," Michele Tagliati, MD, says. "This exciting new research provides hope that one day we may be able to detect and take early action to prevent this disease in at-risk individuals." Tagliati was a co-author of the study.

FURTHER INSIGHTS INTO PARKINSON'S AND DIABETES

Tagliati and his team of investigators are studying the potential benefits of liraglutide, a diabetes medication, for patients with Parkinson's disease who do not have diabetes. "This is definitely a novel approach to the treatment of Parkinson's disease," Tagliati says. "Not just symptomatically, we are going to see if this medication can improve Parkinson's disease, modify the progression of the disease, and make it slower and less disabling." The Phase II clinical trial is expected to be completed in June 2021.

3,254
Movement Disorders Program outpatient visits in FY2020

NEUROIMAGING

The new Neuroimaging Program in the Department of Neurology at Cedars-Sinai is assembling a multidisciplinary team of scientists, engineers and clinicians to harness the strong potential of cutting-edge neuroimaging techniques for improving patient care.

Pascal Sati, PhD
Director, Neuroimaging Program, Acting Associate Professor, Departments of Neurology and Biomedical Sciences

Pascal Sati, PhD, joined Cedars-Sinai to lead the Neuroimaging Program from the National Institutes of Health's intramural research program. "At Cedars-Sinai, we have a tremendous opportunity to build a dynamic, multidisciplinary environment ahead of the technology curve and shape the future of clinical imaging and neurology," Sati says. "We will not only integrate and deploy these technologies into our clinical practice, but also develop innovative neuroimaging strategies that advance our understanding of the mechanisms driving neuroinflammation, neurodegeneration and neurorepair."

RESEARCH SPOTLIGHT

While at the NIH, Sati and colleagues discovered novel imaging biomarkers specific to the pathophysiology of MS. One of these biomarkers—known as the central vein sign (CVS)—is currently being investigated in a multicenter study funded by a grant from the National Institute of Neurological Disorders and Stroke.

This study, co-led by Cedars-Sinai and the Cleveland Clinic, will utilize advanced brain MRI techniques invented by Sati to demonstrate an earlier and more accurate diagnosis of MS by using CVS, replacing the current diagnostic criteria. The Neuroimaging Program at Cedars-Sinai aims to expand the clinical use of these innovative imaging techniques by combining them with artificial intelligence to investigate a broad spectrum of neurological conditions, such as amyotrophic lateral sclerosis (ALS), Alzheimer's disease, brain tumors, Parkinson's disease and stroke.

$7.2M
NIH funding for multicenter brain-imaging study

6
peer-reviewed papers since program inception in April 2020

NEUROVASCULAR / STROKE

The Comprehensive Stroke Center at Cedars-Sinai is a leader in treating vascular disorders affecting the brain and spinal cord.

In the past year, our stroke treatment and research team has continued to break new ground in our approach to stroke surgery, neurointervention and neurointensive care with a dedicated focus on brain aneurysms, carotid artery disease, acute stroke, blood vessel malformations, blood hemorrhages and trauma.

Shlee Song, MD
Director, Vascular Neurology, Director, Comprehensive Stroke and Telestroke Programs, Co-Director, Comprehensive Stroke Center, Associate Professor of Neurology

Michael Alexander, MD
Vice Chair, Neurosurgery, Director, Neurovascular Center and Endovascular Neurosurgery, Co-Director, Comprehensive Stroke Center

RESEARCH SPOTLIGHTS

INTERCRANIAL STENT MAY REDUCE LONG-TERM STROKE RISK

Recent research led by Michael Alexander, MD, has shown that stenting cholesterol-blocked arteries in the brain can be performed safely and reduce stroke risk in patients with severe intracranial atherosclerotic disease.

The WEAVE (Wingspan Stent System Post Market Surveillance) trial demonstrated a significantly lower periprocedural stroke and death rate of 2.6% (compared to 14.7% in a previous clinical trial and the Food and Drug Administration's target of 4%). A followup trial completed in 2020, Wingspan One Year Vascular Imaging Events and Neurologic Outcomes (WOVEN), demonstrated approximately 30% reduced risk over one year for stroke in patients stented for intracranial atherosclerotic disease (ICAD) compared to patients treated with medical therapy only. Alexander is the national principal investigator of the WEAVE and WOVEN trials.

Although angioplasty and stenting have been utilized in other vascular systems, coronary arteries, carotid arteries and peripheral arteries, intracranial stenting for symptomatic ICAD was not well-established prior to Alexander's research. A previous prospective randomized trial (Stenting and Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis, or SAMMPRIS) demonstrated a high periprocedural stroke and death rate of 14.7% in patients who received stents; this severely impaired the use of stenting for intracranial arterial disease in the U.S.

MRA VESSEL WALL IMAGING FOR STROKE PATIENTS

Shlee Song, MD, is lead investigator in the Whole Brain Vessel Wall Imaging in Stroke Patients (WISP) study, a registry of acute ischemic stroke patients who undergo 3D whole-brain vessel wall MR studies within eight weeks of symptom onset. Patterns of ICAD are identified with stroke clinical features to develop ways to track disease progression and therapeutic benefits of stroke prevention.

8.7%

Cedars-Sinai's Comprehensive Stroke Center has the **lowest mortality rate in the U.S. for ischemic strokes among Medicare patients**.

Cedars-Sinai has the **lowest 10-year mean mortality for embolization of ruptured aneurysms** in California, according to the Vizient database.

SPINE

The Cedars-Sinai Spine Center is one of the nation's highest-volume spine centers and provides expert treatment for more than 30 conditions of the spine, from back pain to rare disorders like Arnold-Chiari malformation.

Theodore B. Goldstein, MD
Vice Chair, Spine Surgery, Orthopaedics, Clinical Professor, Orthopaedics, Co-Medical Director, Spine Center

J. Patrick Johnson, MD
Co-Medical Director, Spine Center, Vice Chair, Neurosurgery

Our multidisciplinary approach, in coordination with the Pain Center and the Orthopaedics and Neurosurgery departments, is complemented by rigorous research, and our patients participate in a number of clinical trials and studies.

TECHNOLOGY

In January 2020, our team of neurosurgeons at the Spine Center began employing the Mazor X Stealth Edition for robotic-assisted surgery. This cutting-edge navigation technology gives neurosurgeons real-time visualization of the implant entering the anatomy and allows use of 3D software to create a predetermined blueprint for accurately placing hardware during the procedure.

"The technology that we have at our fingertips as spine surgeons at Cedars-Sinai—including the Mazor X robot, ultrasonic drills and the new artificial intelligence surgical planning—helps us take the best care possible of our spine patients," says Tiffany Perry, MD, assistant professor of Neurosurgery.

RECRUITMENT SPOTLIGHT

David L. Skaggs, MD, MMM, a world-renowned expert in the treatment of children with spinal deformity, recently joined Cedars-Sinai as co-director of the Spine Center, director of Pediatric Orthopaedics, and executive vice chair of the Department of Orthopaedics.

A leading authority in kyphosis, scoliosis, complex trauma, fractures, hip disorders and spinal deformities in children, Skaggs has published more than 250 peer-reviewed articles and has authored over 30 highly cited chapters and textbooks in pediatric orthopaedics.

Skaggs received his medical degree from Columbia University's Vagelos College of Physicians and Surgeons and completed his residency at NewYork-Presbyterian/ Columbia University Irving Medical Center. He also completed a pediatric orthopaedic fellowship at Children's Hospital Los Angeles and a fellowship in orthopaedic research at Columbia University.

2,282
spine surgeries performed

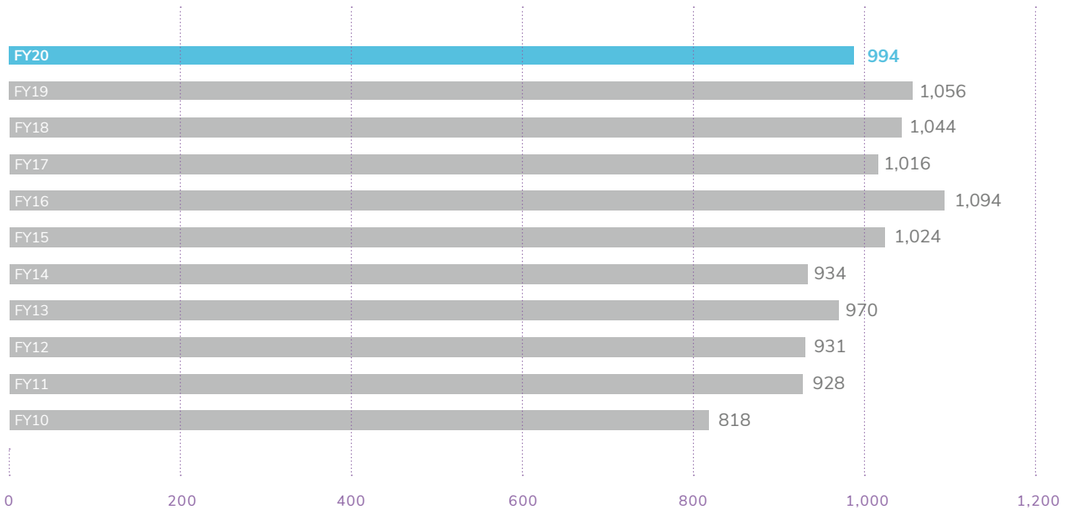
11,845
patients evaluated in the Spine Center

METRICS

VOLUME

VISITS FY20	Neurology	Neurosurgery	Combined
Inpatient	1,967	1,922	
Outpatient	33,831	12,621	
Total	**35,798**	**14,543**	**50,341**

STROKE



SURGICAL VOLUMES

401
Brain Tumor

2,282
Spine

362
Interventional Radiology

241
Neurovascular

No. 2

Cedars-Sinai Medical Center is ranked **No. 2 in California** for inpatient discharges.

QUALITY OF CARE

8.7%

Lowest 30-day ischemic stroke mortality rate in the nation and among teaching hospitals

(better than national rate of 13.6%)

86.8%

of acute ischemic stroke patients receive intravenous tissue plasminogen activator therapy within 45 minutes of hospital admission

0.71

Lowest mean mortality index for endovascular treatment of ruptured brain aneurysms of all California UHC hospitals for the past 10 years

(national average: 0.86)

RESEARCH

PUBLICATIONS

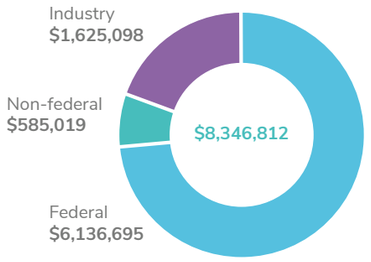
60 Neurosurgery

65 Neurology

GRANT SPENDING

	Neurology	Neurosurgery
Federal	$1,431,569	$4,705,126
Non-federal	$464,275	$120,744
Industry	$1,202,949	$422,149
Total	**$3,098,793**	**$5,248,019**

TOTAL



PHILANTHROPIC DONATIONS

2020:

$8,430,442

2010–20:

$65,395,835

EDUCATION

10 FELLOWSHIP PROGRAMS

- Clinical Neurophysiology
- Endovascular Surgery
- Movement Disorders
- Multiple Sclerosis / Neuroimmunology
- Neurocritical Care
- Neuromuscular Medicine
- Neuromuscular Translational Research
- Neurosurgery Oncology
- Spine Surgery
- Vascular Neurology

15 fellows enrolled

2 new fellowship programs to launch in 2021

(in Neuro-oncology and Neurophysiology)

14 Neurosurgery residents, up from 11, and a full complement of 15 Neurology residents

KEY FACULTY RECRUITS

Maranatha Ayodele, MD
Neurocritical Care Intensivist, Neurology/Neurosurgery

Lisa Bateman, MD, FRCPC
Director, Cedars-Sinai Health System Surgical Epilepsy Program

Paula Eboli, MD
Medical Director, Endovascular Surgery, TMMC/CSMC

Michael Gezalian, MD
Neurocritical Care Intensivist, Neurology/Neurosurgery

Brooke Guerrero, MD
Faculty Neurologist, Multiple Sclerosis and Neuroimmunology

Surasak Phuphanich, MD
Neuro-oncologist, SOCCI/ Neurosurgery

Lindsey Ross, MD
Faculty Neurosurgeon, TMMC/CSMC

Pascal Sati, PhD
Director, Neuroimaging Laboratory

Zaldy Tan, MD, MPH, FACP
Director, Cedars-Sinai Health System Memory and Aging Program; Medical Director, Jona Goldrich Center for Alzheimer's and Memory Disorders; Carmen and Louis Warschaw Endowed Chair in Neurology

SELECTED PUBLICATIONS

NEUROSURGERY

Nisson PL, Ley E, Chu RM. Electric Scooters: Case Reports Indicate a Growing Public Health Concern. **Am J Public Health**. 2020;110(2):177-9. Epub 2020/01/09. doi: 10.2105/AJPH.2019.305499. PubMed PMID: 31913672; PMCID: PMC6951375.

Kim GB, Rincon Fernandez Pacheco D, Saxon D, Yang A, Sabet S, Dutra-Clarke M, Levy R, Watkins A, Park H, Abbasi Akhtar A, Linesch PW, Kobritz N, Chandra SS, Grausam K, Ayala-Sarmiento A, Molina J, Sedivakova K, Hoang K, Tsyporin J, Gareau DS, Filbin MG, Bannykh S, Santiskulvong C, Wang Y, Tang J, Suva ML, Chen B, Danielpour M, Breunig JJ. Rapid Generation of Somatic Mouse Mosaics with Locus-Specific, Stably Integrated Transgenic Elements. **Cell**. 2019;179(1):251-67 e24. Epub 2019/09/21. doi: 10.1016/j.cell.2019.08.013. PubMed PMID: 31539496.

Gonzalez NR. Endovascular Thrombectomy Procedure Time and Other Predictors of Futility in Acute Ischemic Stroke Interventions. **J Am Coll Cardiol.** 2019;73(8):891-2. Epub 2019/03/02. doi: 10.1016/j.jacc.2018.12.031. PubMed PMID: 30819355.

Vergallo A, Houot M, Cavedo E, Lemercier P, Vanmechelen E, De Vos A, Habert MO, Potier MC, Dubois B, Lista S, Hampel H, group IN-ps, Alzheimer Precision Medicine I, Koronyo-Hamaoui M, Black KL. Brain Abeta load association and sexual dimorphism of plasma BACE1 concentrations in cognitively normal individuals at risk for AD. Alzheimer's & dementia: **the journal of the Alzheimer's Association.** 2019;15(10):1274-85. Epub 2019/10/20. doi: 10.1016/j.jalz.2019.07.001. PubMed PMID: 31627825.

Koronyo-Hamaoui M, Sheyn J, Hayden EY, Li S, Fuchs DT, Regis GC, Lopes DHJ, Black KL, Bernstein KE, Teplow DB, Fuchs S, Koronyo Y, Rentsendorj A. Peripherally derived angiotensin converting enzyme-enhanced macrophages alleviate Alzheimer-related disease. **Brain: a journal of neurology.** 2020;143(1):336-58. Epub 2019/12/04. doi: 10.1093/brain/awz364. PubMed PMID: 31794021; PMCID: PMC6935752.

Shi H, Koronyo Y, Rentsendorj A, Regis GC, Sheyn J, Fuchs DT, Kramerov AA, Ljubimov AV, Dumitrascu OM, Rodriguez AR, Barron E, Hinton DR, Black KL, Miller CA, Mirzaei N, Koronyo-Hamaoui M. Identification of early pericyte loss and vascular amyloidosis in Alzheimer's disease retina. **Acta neuropathologica.** 2020;139(5):813-36. Epub 2020/02/12. doi: 10.1007/s00401-020-02134-w. PubMed PMID: 32043162; PMCID: PMC7181564.

Minxha, J., Adolphs, R., Fusi, S., Mamelak, A. N., & Rutishauser, U. (2020). Flexible recruitment of memory-based choice representations by the human medial frontal cortex. **Science**, 368(6498).

Mosher CP, Wei Y, Kaminski J, Nandi A, Mamelak AN, Anastassiou CA, Rutishauser U. Cellular Classes in the Human Brain Revealed In Vivo by Heartbeat-Related Modulation of the Extracellular Action Potential Waveform. **Cell reports.** 2020;30(10):3536-51 e6. Epub 2020/03/12. doi: 10.1016/j.celrep.2020.02.027. PubMed PMID: 32160555; PMCID: PMC7159630.

Kaminski J, Brzezicka A, Mamelak AN, Rutishauser U. Combined Phase-Rate Coding by Persistently Active Neurons as a Mechanism for Maintaining Multiple Items in Working Memory in Humans. **Neuron.** 2020;106(2):256-64 e3. Epub 2020/02/23. doi: 10.1016/j.neuron.2020.01.032. PubMed PMID: 32084331; PMCID: PMC7217299.

Wen PY, Reardon DA, Armstrong TS, Phuphanich S, Aiken RD, Landolfi JC, Curry WT, Zhu JJ, Glantz M, Peereboom DM, Markert JM, LaRocca R, O'Rourke DM, Fink K, Kim L, Gruber M, Lesser GJ, Pan E, Kesari S, Muzikansky A, Pinilla C, Santos RG, Yu JS. A Randomized Double-Blind Placebo-Controlled Phase II Trial of Dendritic Cell Vaccine ICT-107 in Newly Diagnosed Patients with Glioblastoma. **Clin Cancer Res.** 2019;25(19):5799-807. Epub 2019/07/20. doi: 10.1158/1078-0432. CCR-19-0261. PubMed PMID: 31320597.

NEUROLOGY

Allen JA, Merkies ISJ, Lewis RA. Monitoring Clinical Course and Treatment Response in Chronic Inflammatory Demyelinating Polyneuropathy During Routine Care: A Review of Clinical and Laboratory Assessment Measures. **JAMA neurology.** 2020. Epub 2020/04/28. doi: 10.1001/jamaneurol.2020.0781. PubMed PMID: 32338716.

Sasannejad C, Ely EW, Lahiri S. Long-term cognitive impairment after acute respiratory distress syndrome: a review of clinical impact and pathophysiological mechanisms. **Critical Care** (London, England). 2019;23(1):352. Epub 2019/11/14. doi: 10.1186/s13054-019-2626-z. PubMed PMID: 31718695; PMCID: PMC6852966.

Van Schaik IN, Mielke O, Bril V, van Geloven N, Hartung HP, Lewis RA, Sobue G, Lawo JP, Praus M, Durn BL, Cornblath DR, Merkies ISJ, group Ps. Long-term safety and efficacy of subcutaneous immunoglobulin IgPro20 in CIDP: PATH extension study. **Neurology Neuroimmunology & Neuroinflammation.** 2019;6(5):e590. Epub 2019/07/30. doi: 10.1212/NXI.0000000000000590. PubMed PMID: 31355323; PMCID: PMC6624149.

Sahai SK, Maghzi AH, Lewis RA. Rituximab in late-onset myasthenia gravis is safe and effective. **Muscle & Nerve.** 2020. Epub 2020/04/03. doi: 10.1002/mus.26876. PubMed PMID: 32239711.

Reed CM, Mosher CP, Chandravadia N, Chung JM, Mamelak AN, Rutishauser U. Extent of single-neuron activity modulation by hippocampal interictal discharges predicts declarative memory disruption in humans. **The Journal of neuroscience: the official journal of the Society for Neuroscience.** 2019. Epub 2019/11/23. doi: 10.1523/JNEUROSCI.1380-19.2019. PubMed PMID: 31754015.

Guerrero BL, Sicotte NL. Microglia in Multiple Sclerosis: Friend or Foe? **Front Immunol.** 2020;11:374. Epub 2020/04/09. doi: 10.3389/fimmu.2020.00374. PubMed PMID: 32265902; PMCID: PMC7098953.

Hu Z, Christodoulou AG, Wang N, Shaw JL, Song S, Maya MM, Ishimori ML, Forbess LJ, Xiao J, Bi X, Han F, Li D, Fan Z. Magnetic resonance multitasking for multidimensional assessment of cardiovascular system: Development and feasibility study on the thoracic aorta. **Magn Reson Med.** 2020 Nov;84(5):2376-2388. doi: 10.1002/mrm.28275. Epub 2020 Apr 16. PMID: 32301164.

Zha AM, Chung LS, Song S, Majersik JJ, Jagolino-Cole AL. Training in Neurology: Adoption of resident teleneurology training in the wake of COVID-19: Telemedicine crash course. **Neurology.** 2020 Sep 1;95(9):404-407. doi: 10.1212/WNL.0000000000010029. Epub 2020 Jun 17. PMID: 32554768; PMCID: PMC7538229.

Sidtis JJ, Sidtis DVL, Ramdhani R, Tagliati M. Speech Intelligibility During Clinical and Low Frequency. **Brain Sci.** 2020;10(1). Epub 2020/01/08. doi: 10.3390/brainsci10010026. PubMed PMID: 31906549; PMCID: PMC7016584.

Laperle AH, Sances S, Yucer N, Dardov VJ, Garcia VJ, Ho R, Fulton AN, Jones MR, Roxas KM, Avalos P, West D, Banuelos MG, Shu Z, Murali R, Maidment NT, Van Eyk JE, Tagliati M, Svendsen CN. iPSC modeling of young-onset Parkinson's disease reveals a molecular signature of disease and novel therapeutic candidates. **Nat Med.** 2020;26(2):289-99. Epub 2020/01/29. doi: 10.1038/s41591-019-0739-1. PubMed PMID: 31988461.

Artusi CA, Dwivedi A, Romagnolo A, Bortolani S, Marsili L, Imbalzano G, Sturchio A, Keeling EG, Zibetti M, Contarino MF, Fasano A, Tagliati M, Okun MS, Espay AJ, Lopiano L, Merola A. Differential response to pallidal deep brain stimulation among monogenic dystonias: systematic review and meta-analysis. **Journal of Neurology, Neurosurgery, and Psychiatry.** 2020;91(4):426-33. Epub 2020/02/23. doi: 10.1136/jnnp-2019-322169. PubMed PMID: 32079672.

HONORS AND AWARDS

Nestor Gonzalez, MD: Transformational Project Award, American Heart Association

Marwa Kaisey, MD: National MS Society 2020 Healthcare Professional Champion of the Year

Maya Koronyo-Hamaoui, PhD: AlzForum Notation on *Acta Neuropathologica* 2020 Paper on Retinal Vascular Pathology in AD; NIH/NIA Featured Research; Goldman-Rakic Prize Nomination for Outstanding Achievement in Cognitive Neuroscience

Shouri Lahiri, MD: Top Reviewer, *Neurocritical Care* (2019 and 2020); American Indian Neurological Association Research Award (2020)

Ueli Rutishauser, PhD: Inaugural Board of Governors Chair in Neurosciences

Nancy Sicotte, MD: 2020–2021 Fellow, Hedwig van Ameringen Executive Leadership in Academic Medicine Program for Women; Chair, National Medical Advisory Committee, National MS Society

John Yu, MD: 2019 Albert Nelson Marquis Lifetime Achievement Award

LEADERSHIP POSITIONS ON NATIONAL COMMITTEES AND JOURNALS

Jessica Besbris, MD: American Academy of Neurology Palliative Care Section Chair; American Academy of Hospice and Palliative Medicine Neuropalliative Special Interest Group Co-Chair; International Neuropalliative Care Society Education Committee Vice-Chair

Keith Black, MD: Member, State of California Alzheimer's Prevention and Preparedness Task Force, 2019–present

Moise Danielpour, MD: Editor-In-Chief, *Pediatric Neurosurgery*; Elected, Little People of America Medical Advisory Board; Executive Medical Board Member, Margaret Hackett Family Foundation

Nestor Gonzalez, MD: Stroke Neurovascular Intervention Science Committee, AHA Stroke Council; Official Representative of the American Heart Association, American Academy of Neurology Guidelines Committee

Maya Koronyo-Hamaoui, PhD: Editorial board Member, *Alzheimer's & Dementia*, *Journal of Clinical Medicine* and *Frontiers in Immunology*

Shouri Lahiri, MD: 2020 Scientific Reviewer for Psychological Health/ Traumatic Brain Injury Research Program, Department of Defense Congressionally Directed Medical Research Programs

Richard Lewis, MD: Chair-elect, Peripheral Nerve Society, 2020

Manuel Perez, PhD: Associate Editor, *Nanotheranostics*

Wouter Schievink, MD: Co-Chairman, SIH Guidelines Committee; Advisory Board Member of SIH Coding, ICD11, American Headache Society

Shlee Song, MD: Member, *Stroke Journal* Editorial Board; Co-Editor, *Stroke Journal* blog

REFERRAL RESOURCES

424-315-2444
cedars-sinai.org/neuro

Doctors from around the world refer patients to the neurology and neurosurgery specialists at Cedars-Sinai, who are trained to treat conditions ranging from brain tumors to multiple sclerosis, epilepsy and stroke.

If you have a patient you would like to refer to one of our programs, please contact us at 424-315-2444 or visit cedars-sinai.org/neuro. Our physicians will work with you to understand the unique needs of your patient, develop the best treatment plan, and be available for additional consultations and procedures as needed.

FACULTY DIRECTORY

DEPARTMENT OF NEUROLOGY

Epilepsy
Lisa Bateman, MD
Jeffrey Chung, MD
Chrystal Reed, MD, PhD

Memory Disorders
Zaldy Tan, MD, MPH

Movement Disorders
Michele Tagliati, MD
Echo Tan, MD
Elliot Hogg, MD

Multiple Sclerosis/ Neuroimmunology
Nancy Sicotte, MD
Marwa Kaisey, MD
Brooke Guerrero, MD

Nerve & Muscle
Richard Lewis, MD
Matthew Burford, MD
Abirami Muthukumaran, MD

Neurocritical Care
Shouri Lahiri, MD
Shahed Toossi, MD
Maranatha Ayodele, MD
Michael Gezalian, MD

Stroke
Shlee Song, MD
Konrad Schlick, MD

DEPARTMENT OF NEUROSURGERY

Brain Tumor
Keith L. Black, MD
Ray Chu, MD
Jethro Hu, MD
Chirag Patil, MD
Surasak Phuphanich, MD
Jeremy Rudnick, MD
John Yu, MD

CSF Leak
Wouter Schievink, MD

Neurovascular
Michael Alexander, MD
Paula Eboli, MD
Nestor Gonzalez, MD

Pediatric Neurology & Neurosurgery
Moise Danielpour, MD
Tyler Pierson, MD, PhD
Yana Tavyev, MD

Pituitary
Adam Mamelak, MD

Spine
Tiffany Perry, MD
Alexander Tuchman, MD
Lindsey Ross, MD

CEDARS-SINAI
Departments of Neurology and Neurosurgery
8700 Beverly Blvd.
Advanced Health Sciences Pavilion Suite A6600
Los Angeles, CA 90048