

OHSU BRAIN INSTITUTE

# Cerebrovascular Services

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OHSU Physician Consult and Referral Service

503-494-4567

TOLL-FREE 800-245-6478

Transfer Center (for Acute Stroke Patient Transfers to OHSU)

503-494-7000



## Welcome to this overview of cerebrovascular services at OHSU.

While caring for stroke patients is some of the most urgent work we do, OHSU cerebrovascular services include care and research for all cerebrovascular conditions, from arteriovenous malformations to traumatic brain injury and seizures. OHSU has some of the most advanced cerebrovascular care available anywhere in the world. Our multidisciplinary care team includes neurologists and neurosurgeons dual trained in neurointervention. Additionally, we offer neurocritical care nursing in a Magnet-recognized hospital, the most advanced imaging available and more than 20 years of national clinical trial leadership.

The OHSU Stroke Program is the Northwest's first comprehensive stroke center certified by The Joint Commission. For many years, we have offered outstanding care for patients with all types of stroke and related conditions. OHSU holds a Gold Plus Quality Achievement Award for outstanding adherence in the Get With The Guidelines program. We are pleased to share that *U.S. News & World Report* magazine ranked our neurology and neurosurgery departments among the top 50 in the country.

However, our highest reward is our relationships with patients and providers. We continually strive for seamless coordinated care for patients among OHSU specialists and rapid communication with community providers, often via telemedicine. Our telestroke program now includes 12 locations around the region, and we are constantly seeking new ways to make access easier for you and your patients. Finally, you can be assured that our quality advisory board oversees all we do, ensuring we remain a strong resource for you and your patients.

We're proud to be your partner in caring for cerebrovascular patients.

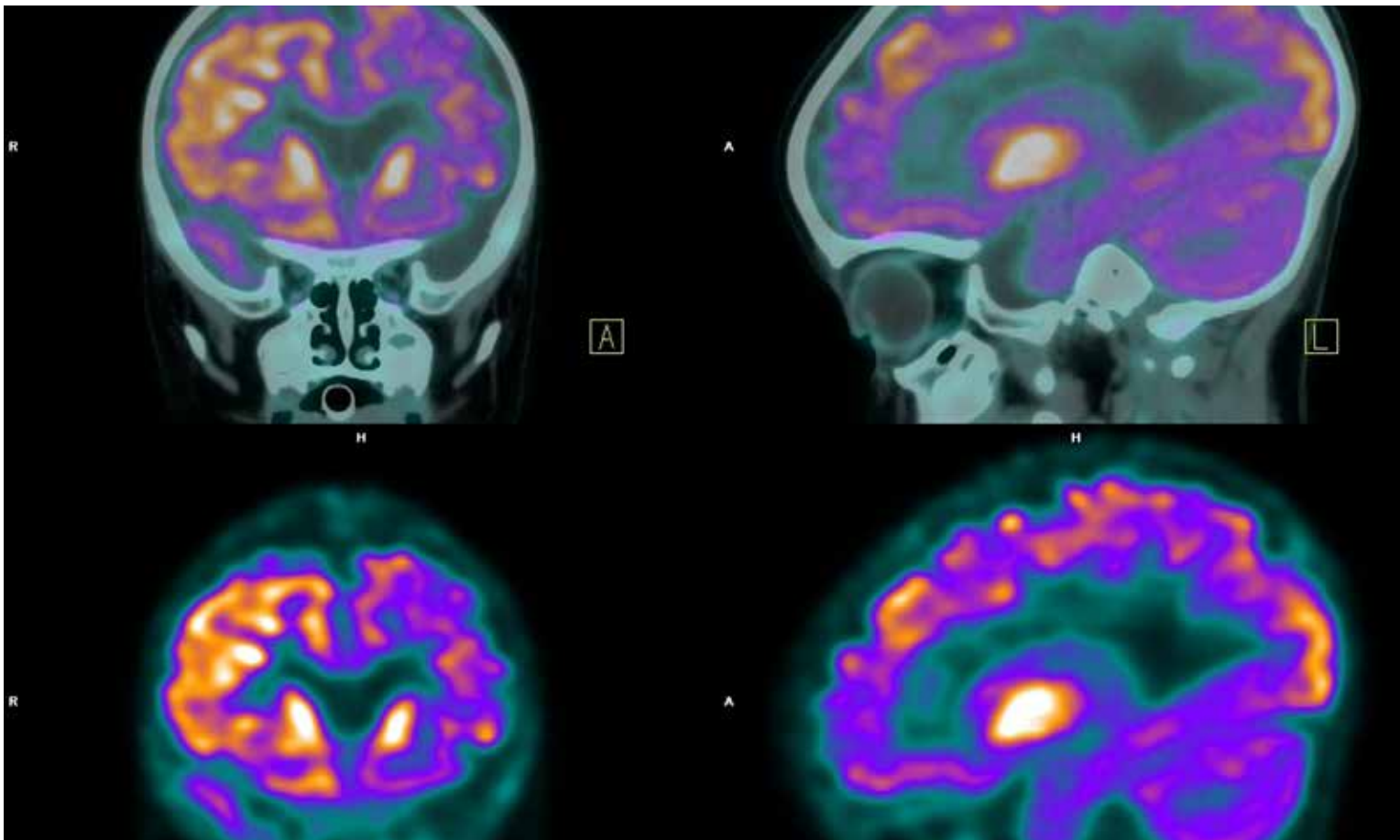
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If you have questions or would like to consult with a specialist, please contact our Physician Consult & Referral Service at 503-494-4567 or visit [www.ohsubrain.com](http://www.ohsubrain.com). For acute stroke patient transfers to OHSU, please call the Transfer Center at 503-494-7000.

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## Diseases and conditions treated

We offer the most advanced treatments for cerebrovascular conditions. Research at OHSU has often led to the development of new, more effective therapies for stroke and other conditions. Learn more about how we can help with the list of conditions below.

### Aneurysm

We offer coiling, clipping, stents and surgical treatment for aneurysms. Patients benefit from advanced imaging techniques, including state-of-the-art angiography and CT perfusion, and a highly experienced multidisciplinary team. OHSU cerebrovascular specialists have performed more than 600 coiling procedures.

### Arteriovenous malformation

Patients with AVMs benefit from treatment in a high-volume surgical center with specialists dual trained in neurosurgery and neurointervention. Before surgery, important feeder vessels can be embolized under the guidance of advanced imaging, increasing patient safety and decreasing potential morbidity associated with AVM resection. In 2016, the OHSU team operated on 15 patients with AVMs.

### Brain tumors requiring presurgical devascularization

Embolization for tumors of the skull base, spine, head and neck can reduce morbidity and increase the safety of resection. For tumor removal, the use of stereotactic navigational imaging helps our surgeons perform craniotomies much more precisely than was possible without this advanced technology. This precision has the advantage of decreasing both tissue damage and healing time.

### Carotid atherosclerosis

We have more than 20 years of experience in angioplasty and stenting and have placed more than 1,500 stents. Endarterectomy is an option for patients who qualify. The North American Symptomatic Carotid Endarterectomy Trial found that patients with more than 50 percent stenosis benefited from endarterectomy more than medical management. We were a leading participant in the CREST trial and are now participating in CREST-2, a study of medical therapy for patients with carotid stenosis who have not had a stroke.



### Dural arteriovenous fistulas

These acquired lesions are caused by abnormal connections between a vein and artery, and treatment can be complex. Risk to the patient is highly variable depending on the location, and symptoms may vary. OHSU's 3-D guidance system allows our team to treat DAVFs and cavernous fistulas with coiling, flow diversion or liquid embolic agents as appropriate, customizing the approach to each patient and lesion. For surgery, our ability to use stereotactic imaging helps to pinpoint the lesion, thus reducing tissue damage and healing time.

### Epistaxis

Most nosebleeds are not severe enough to require more than nasal packing. However, for patients with persistent, recurrent or severe epistaxis that does not respond to other measures, embolization can offer superior control. These patients may be referred from the emergency department or outpatient facilities. Typically, the patient will return home the same day.

### Intracranial atherosclerosis

Patients with this condition may only be identified after they have already had a major stroke. For patients who have already survived a major health event, the expertise of OHSU's cerebrovascular team helps maximize their outcomes. Our experience is second to none as the top-enrolling site in the SAMMPRIS (Stenting versus Aggressive Medical Management for Preventing Recurrent Stroke in Intracranial Stenosis) trial. As a result, aggressive medical management is now the first-line therapy at OHSU before considering angioplasty and stenting.

#### **Uncommon causes of stroke: Diagnosis and guidance**

The OHSU stroke team is a particularly knowledgeable resource in the region for patients who have atypical causes of stroke, including blood vessel disorders (such as fibromuscular dysplasia), clotting disorders (such as antiphospholipid antibody syndrome) and hereditary disorders (such as cerebral autosomal-dominant arteriopathy with subcortical infarcts and leukoencephalopathy, known as CADASIL). Though many of these issues don't have a procedural intervention available, our team will address each case medically for symptomatic treatment and guide the patient through what to expect based on our experience of caring for similar cases.

#### **Moyamoya disease**

This rare and congenital condition appears in childhood. Adult patients almost exclusively present with internal carotid artery occlusion causing ischemic stroke or hemorrhage. Our team and OHSU Doernbecher Children's Hospital specialists are experienced at performing intracranial bypass to treat this condition.

#### **Pediatric neurovascular disease**

AVMs, aneurysms and other vascular lesions can present in children. The direct association with OHSU Doernbecher Children's Hospital and clinics means our neurointerventionalists have vast experience in the care of children, including vascular concerns of the brain and spine.

Our team works closely with the three pediatric neurosurgeons and five pediatric head and neck surgeons at OHSU and Doernbecher. Children and families benefit from Doernbecher's specialized team, including pediatric anesthesiologists and intensive care nursing.

#### **Spinal conditions**

OHSU treats many spine-related conditions. We treat pain associated with spinal compression fractures, spinal vascular conditions such as spinal AVM, and dural fistulas.

#### **Stroke and related conditions**

The OHSU Stroke Program is a national leader in stroke treatment. Directed by Wayne Clark, M.D., and Aclan Dogan, M.D., the program treats hundreds of patients per year with tPA, stenting, embolization or neuroprotection. In 2016, the team treated 563 strokes. The team has also placed more than 1,500 carotid stents since we began using this therapy in the late 1990s.

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To learn more about our stroke program and treatments, please turn to page 16.

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## Comprehensive imaging

OHSU offers state-of-the-art cerebrovascular imaging services, from the complete range of standard modalities to the most advanced technology. Primary providers and consultants can quickly see detailed anatomic and physiologic processes and determine the best treatment for each patient. Imaging is tailored to diagnostic questions.

### The latest imaging technology

At OHSU, patients benefit from the most advanced imaging technology available. OHSU maintains nine MRI magnets including:

- Three Philips 3T wide-bore Ingenias
- Two Philips 1.5T Achievas
- Philips 3T Achieva
- Philips 1T high-field open MRI
- Philips 1.5T wide-bore Ingenia
- Siemens 3T intraoperative

All MRI scanners include state-of-the-art echo-planar imaging, MR spectroscopy, susceptibility-weighted imaging (SWI), diffusion tensor imaging with fiber tracking, functional MRI, and MRI perfusion including ASL and DSC methods. OHSU maintains nine CT units including:

- Philips ICT 256
- Two Philips 64s
- Toshiba Aquillion
- Three Philips 16 multidetectors
- Two hybrid Philips 16 scanners, including a PET/CT and SPECT/CT





## Experienced, multidisciplinary imaging team

Our fellowship-trained imaging specialists are board certified by the American Board of Radiology and hold the Certificate of Additional Qualification in neuroradiology. They collaborate with all OHSU clinical and medical teams, including but not limited to neurosurgery, interventional neuroradiology, otolaryngology and orthopaedic and vascular surgery.

## Imaging techniques for cerebrovascular conditions

### Aneurysm evaluation

Angiography is the modality used for aneurysm treatment decisions. We can also use CT angiography, MRI and magnetic resonance angiography, but standard angiography with contrast is the definitive modality.

### Aneurysm screening

Incidence of intracranial aneurysms approaches 9 percent in patients who have more than one first-degree relative with an aneurysm. These patients should be screened with MR or CT angiography, both available at OHSU. Patients with pseudoxanthoma elasticum and polycystic kidney disease should also be screened.

For finding aneurysms of 3 to 5 mm, we offer 3-D time-of-flight MRA with our Philips 3.0 Tesla scanner. This modality is shown to have greater than 95 percent sensitivity and accuracy for aneurysm detection.

Patients with small, asymptomatic aneurysms should be screened with noncontrast MRA, with repeat screening in a year. If the aneurysm is stable, they can be rescreened at two and three years.

### Cerebral angiography

We use intra-arterial digital subtraction angiography, or IADSA, which captures digital images from angiography with contrast. Cerebral angiography has many uses, including detecting and evaluating aneurysms, arteriovenous malformations, atherosclerosis, tumors, blood clots and stroke.

### Congenital malformations

All appropriate imaging options are available to diagnose and evaluate congenital malformations in adult and pediatric patients. We work with pediatric specialists at OHSU Doernbecher Children's Hospital for timely, comfortable children's imaging.

## Seizure evaluation

A CT is usually the first imaging ordered for patients presenting to the emergency department with a seizure, because it is available quickly and can help rule out acute neurological problems and diagnose hemorrhages, large tumors and other conditions.

High-field MRI with a 3.0 Tesla magnet, readily available at OHSU, is more sensitive for helping identify seizure etiology. Specialized MRI techniques, functional MRI, PET scan and SPECT imaging are also helpful in epilepsy diagnosis and treatment.

## Stroke evaluation

The immediate goal of imaging for stroke evaluation is to determine the source of the embolism or low blood flow. In addition to angiography, we use the following modalities:

- **CT perfusion**

We offer CT perfusion scanning, or CTP, as appropriate, and have spiral (helical) CT capabilities and a multidetector CT scanner to quickly find regions of low perfusion and characterize blockages. OHSU uses RAPID CT perfusion software to rapidly generate quantified post-processed perfusion images which help triage patients with acute stroke symptoms. Our radiologists use those perfusion images to both diagnose acute infarcts and to determine the optimal therapeutic intervention based on the imaging results.

- **MRI perfusion**

Perfusion-weighted imaging can be done along with standard magnetic resonance imaging and MR angiography. This takes less than 15 minutes and, combined with diffusion-weighted imaging, is highly sensitive for precisely mapping the ischemic zone in the patient's brain. It can also provide a map of blood volume.

- **High-resolution vascular imaging and analysis**

These modalities include CT angiography, MR angiography and contrast-enhanced MRA. Advanced MR imaging aids in more precise assessment of brain tumors and more informed therapeutic decisions. We use perfusion MR imaging and diffusion-weighted MR imaging in addition to more traditional modalities. Multidetector CT angiography has been associated with greater than 97 percent sensitivity and specificity to detect aneurysms, and better detection of aneurysms smaller than 4 millimeters.

OHSU is home to the multidisciplinary Dotter Interventional Institute, a leader in clinical practice, training and research. Charles Dotter, M.D., for whom the Institute is named, pioneered arterial angioplasty in 1964 at OHSU. This was followed by the development of vascular stents and many other basic interventional techniques.

## Traumatic brain injury

From noncontrast CT to advanced neuroimaging, including functional MRI, PET and SPECT imaging, we have the capabilities to fine-tune diagnoses for patients with suspected TBI.



## Treatment options

Our goal is to provide access to the most advanced treatments for your patients. Every treatment is designed to fit your patients' lifestyles and goals, risk factors and histories.

### Your partner for patient care

While we are your resource for surgery and pre- and postoperative consultation and follow-up, your patients remain in your care. As the OHSU Telehealth Network grows, many patients can receive follow-up care in their home communities.

### Surgical procedures with our team

The cerebrovascular surgeons at OHSU include specialists who have dual training in neurosurgery and neurointervention. The Neuro-Oncology and Skull Base Neurosurgery program provides neurosurgical therapies for skull base tumors, acoustic neuromas and vascular lesions in cooperation with specialists from OHSU otolaryngology. We also offer neurosurgical treatment for vascular abnormalities of the spine.

### Neurointerventional radiology at OHSU

Neurointerventional radiology provides diagnosis and treatment for cerebrovascular conditions with image-guided, minimally invasive techniques. Patients often return home the same day. All of our neurointerventionalists are board certified in their specialties. Our neurointerventional team evaluates or treats more than 1,000 patients per year.

## Acute thrombectomy

Acute thrombectomy is performed for patients with acute blockage of a large blood vessel in the brain, causing or potentially causing a major stroke. This treatment has been studied in a number of trials, including SWIFT and TREVO 2; OHSU was the top enrolling hospital in the nation for the latter.

## Aneurysm options

- **Microsurgical clipping**

Following a standard craniotomy, the OHSU cerebrovascular neurosurgical team precisely locates the aneurysm, dissects it from surrounding tissue and clips the neck of the aneurysm to occlude it permanently. Our team has clipped more than 600 aneurysms in the past 10 years, including 102 procedures in 2015–2016.

- **Embolization, coiling and stenting**

A range of devices and techniques are available to treat brain aneurysms. Each aneurysm presents a unique therapeutic challenge, and the OHSU team evaluates every patient carefully to determine the best technique. For example, an aneurysm with a small neck may be treated with coiling to fill the space and seal off the aneurysm. Sometimes a stent is required to hold the coils in place. For a wide-necked aneurysm, or one with a potentially high risk of recurrence following standard coil embolization, flow diversion is yet another option. In this treatment, a fine mesh stent allows blood flow through branch vessels, but clots off the aneurysm over time.

- **Unruptured aneurysms**

Approximately 3 percent of the population has unruptured intracranial aneurysms, or IAs. These are often found incidentally. Aneurysm size, location, angiographic morphologic characteristics and lifestyle risk factors determine the rupture risk of cerebral aneurysms. Ruptured cerebral aneurysms can lead to potentially fatal subarachnoid hemorrhage.

The main interventions to treat these aneurysms are surgical clipping and endovascular coiling or flow diversion. Risks depend on aneurysm complexity, patient health and other factors. Patients with IAs have better outcomes when treated in high-volume centers, and our surgical and neurointerventional specialists are experienced in treating these lesions.

## Robotics in cerebrovascular surgery

The development of smaller robotic devices promises innovation in cerebrovascular surgery. Currently, microsurgery is done in just 1 or 2 centimeters of space, which is insufficient for the thicker robotic arms of the da Vinci robotic surgery unit. However, we continue to watch this emerging area of cerebrovascular surgery and will include techniques that promise maximum benefit for patients.



### Arteriovenous malformation (brain AVM) treatment

Surgery is the definitive treatment for these congenital malformations, which may progress over time. Focused stereotactic radiosurgery may be an option. Members of our multidisciplinary team work together to individualize AVM treatments. Often, AVMs are embolized before surgical and radiosurgical treatment to facilitate complete treatment and reduce potential risk.

- **Stereotactic radiosurgery for AVMs**

Radiation in the area of an AVM can render it less likely to bleed. However, this treatment typically takes 18 months to two years to be effective, and AVM size determines if this treatment is appropriate. Stereotactic radiosurgery is generally not an option for AVMs larger than 3 centimeters.

If an AVM is difficult to access or in a location associated with extremely high morbidity such as the brain stem, one option is embolization to reduce the AVM, followed by radiosurgery to the deep location.

### Carotid angioplasty and stenting

As an alternative to endarterectomy, carotid angioplasty and stenting is appropriate for selected patients, with or without symptoms. The key advantages of this procedure are avoiding major surgery and anesthesia. This procedure is typically done via a catheter introduced into the femoral artery. After navigation to the carotid artery, the stent is placed following use of an embolic protection device. Patients stay overnight in the hospital for observation and go home the next morning. For the last decade, our team's complication rate is below 3 percent.

### Carotid endarterectomy

The OHSU neurosurgical team performs more than 60 carotid endarterectomy procedures per year. We perform this procedure for patients who have had a transient ischemic attack or stroke in addition to significant plaque in the carotid arteries. It is also appropriate for some patients who have not had a cerebrovascular event, but have significant plaque. Morbidity for this procedure is below 4 percent for the OHSU neurosurgical team in the last decade.

The North American Symptomatic Carotid Endarterectomy Trial found that patients with more than 50 percent stenosis benefited from endarterectomy more than medical management.

### Dural and cavernous fistula embolization

Treatment for dural and cavernous fistulas is similar to that for AVMs — a small artery may be blocked, sometimes with a liquid embolic agent that becomes semisolid. A transvenous approach may be used to block a vein with coiling, or a flow diversion device may be useful.

### Dural venous sinus thrombosis recanalization

Patients with a venous sinus thrombus may present with headache and mild symptoms, and if so, are usually treated with anticoagulation. However, if collateral blood flow is compromised or the clot is extensive, a balloon aspiration thrombectomy or direct injection of thrombolytic medication can be more effective in reducing the risk of major stroke.

### Embolization, tumor

Embolization may be useful before surgery for skull base, head, neck and spinal tumors to decrease surgical complexity, increase safety and reduce blood loss. For example, a patient with a vascular skull base tumor, such as a meningioma or paraganglioma, may benefit from blockage of blood vessels to increase surgical safety and decrease blood loss. Embolization is generally an outpatient procedure.

### Intracranial bypass surgery

This procedure is done to restore blood flow, with the goal of preventing strokes or treating aneurysms. In particular, we perform intracranial bypass for patients with Moyamoya disease. This disease affects a group of blood vessels at the base of the brain, causing acute stroke or a series of transient ischemic attacks.

### Head and neck vascular and tumor treatment

Our 3-D guidance system allows us to evaluate and treat head and neck lesions, combined with or in lieu of an endovascular approach, including head and neck and spinal biopsy and embolization. Head and neck vascular malformations are usually treated with direct puncture and sclerotherapy as the first line of treatment in adults and children. Our multidisciplinary team in the Hemangioma and Vascular Birthmark Clinic includes head and neck surgeons, dermatologists and neurointerventionalists to evaluate these often complex lesions.

Experts from OHSU's Department of Neurological Surgery are among the few nationwide regularly performing bypass surgery for Moyamoya disease and other rare progressive stroke conditions.

## Spine treatment

The pain associated with spinal compression fractures can be limited by performing vertebroplasty or kyphoplasty. This is typically an outpatient procedure, and the patient returns home the same day. This technique can also be utilized in treatment of spinal tumors and vascular malformations. Neurointervention is also an option for treating spinal vascular conditions such as spinal AVM and spinal dural fistula, using similar techniques to those we use to treat this type of pathology in the brain.

## Stroke treatment

At OHSU, rates of serious complications with interventional stroke procedures, including diagnostic angiography, carotid stenting and aneurysm coiling, meet or exceed the national benchmarks established by the American Heart Association, the American Stroke Association and The Joint Commission.

All neurointerventions benefit from the outstanding imaging capabilities at OHSU, OHSU Doernbecher and the adjacent Veterans Affairs Medical Center. We offer three dedicated biplane neurovascular units with three-dimensional capacity for navigation, a technology that has revolutionized neurointerventional care.

### Collaborations with other specialties

A natural link exists between cardiology and neurology in stroke cases. The OHSU stroke team actively collaborates with our cardiology colleagues to evaluate the best treatment for patients. Our team can help assess the risk/benefit of patent foramen ovale (PFO) for closure, as well as the best medical therapy for patients with atrial fibrillation. We are also fortunate to have two neuro-ophthalmologists available to consult, particularly for rare or uncommon causes for stroke.

- **tPA window of opportunity**

The OHSU Stroke Program follows the guideline of considering tissue plasminogen activator, or tPA, for 100 percent of patients within four and a half hours of a stroke or suspected stroke. In fact, we exceed the guidelines by treating most patients within three hours.

- **Endovascular thrombectomy**

While tPA is effective in approximately 50 percent of patients, its efficacy drops to approximately 8 percent in patients with large vessel occlusions. When patients do need neurological surgery at OHSU, they have access to the most advanced endovascular therapies available anywhere. Patients with large clots can receive an endovascular thrombectomy. The surgical team has also been in the forefront of testing the newest “stent clot retriever” devices. Success rates for thrombectomy are approximately 90 percent, with a 65 to 70 percent rate of full neurological recovery. Although the traditional time window for thrombectomy is less than eight hours, OHSU has extended this precious window of opportunity for some patients using advanced perfusion imaging to identify a subset of patients with brains at risk who can safely undergo thrombectomy even after eight hours.

- **Stroke rehabilitation services**

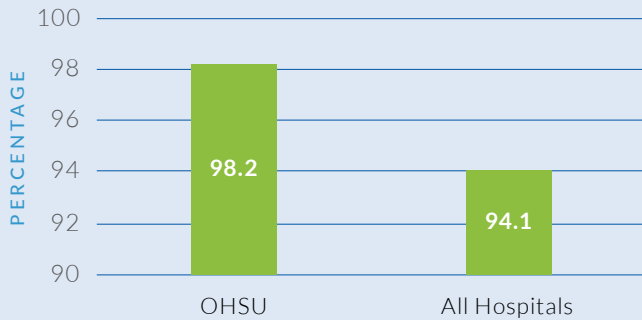
Stroke can leave patients with a wide range of deficits. Our team of experienced neurological therapists provides a holistic approach through integrated services. They combine technology and techniques to give patients help with communication disorders and motor function. OHSU’s intensive rehabilitation program was developed for a study of cortical stimulation several years ago. Early results from that study did not show a

significant difference between patients fitted with a stimulator who also did intensive rehabilitation and a rehabilitation-alone group. However, results were impressive for rehabilitation alone, suggesting that these intensive techniques can make a difference even years after stroke.<sup>1</sup> OHSU was the only center in Oregon to participate in the study and use the protocols, and we continue to provide this therapy. OHSU stroke specialists continue to watch and participate in rehabilitation trials as these technologies develop.



OHSU iMRI suite.

### OHSU Stroke Program Compliance With Joint Commission Core Measures for Comprehensive Stroke Centers



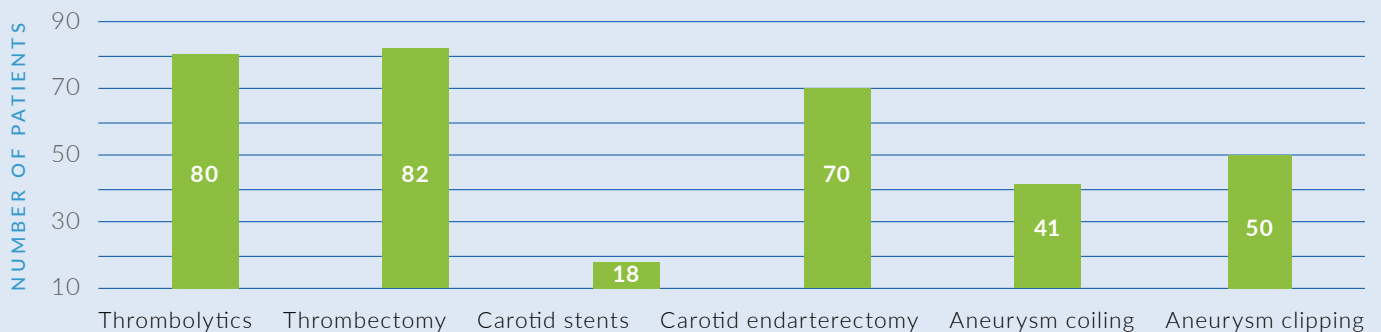
The OHSU Stroke Program is a Joint Commission-certified Comprehensive Stroke Center. We participate in the American Heart Association/American Stroke Association Get With The Guidelines program to track the frequency with which core measures of care are documented for each patient treated for stroke.

#### Nine core measures

1. A National Institutes of Health Stroke Scale score for patients with ischemic strokes within 12 hours of admission.
2. A documented modified Rankin Scale score at 90 days after a stroke.
3. Severity measurement performed for patients with subarachnoid or intracerebral hemorrhage.
4. Initiation of a procoagulant reversal agent for patients who have ICH after thrombolysis.
5. Hemorrhagic transformation rate.
6. Nimodipine treatment administered to patients with SAH.
7. Median time to revascularization.
8. Thrombolysis in cerebral infarction post-treatment reperfusion of grade 2b or greater.
9. Time from arrival to skin puncture.

"All Hospitals" = Joint Commission-certified Comprehensive Stroke Centers who use the AHA/ASA Get With The Guidelines program to track their compliance with reporting on stroke core measures.

### Strokes Treated at OHSU by Treatment Type, January–December 2016



This graph shows the number of strokes, by treatment type, treated at the OHSU Stroke Program from January–December 2016.



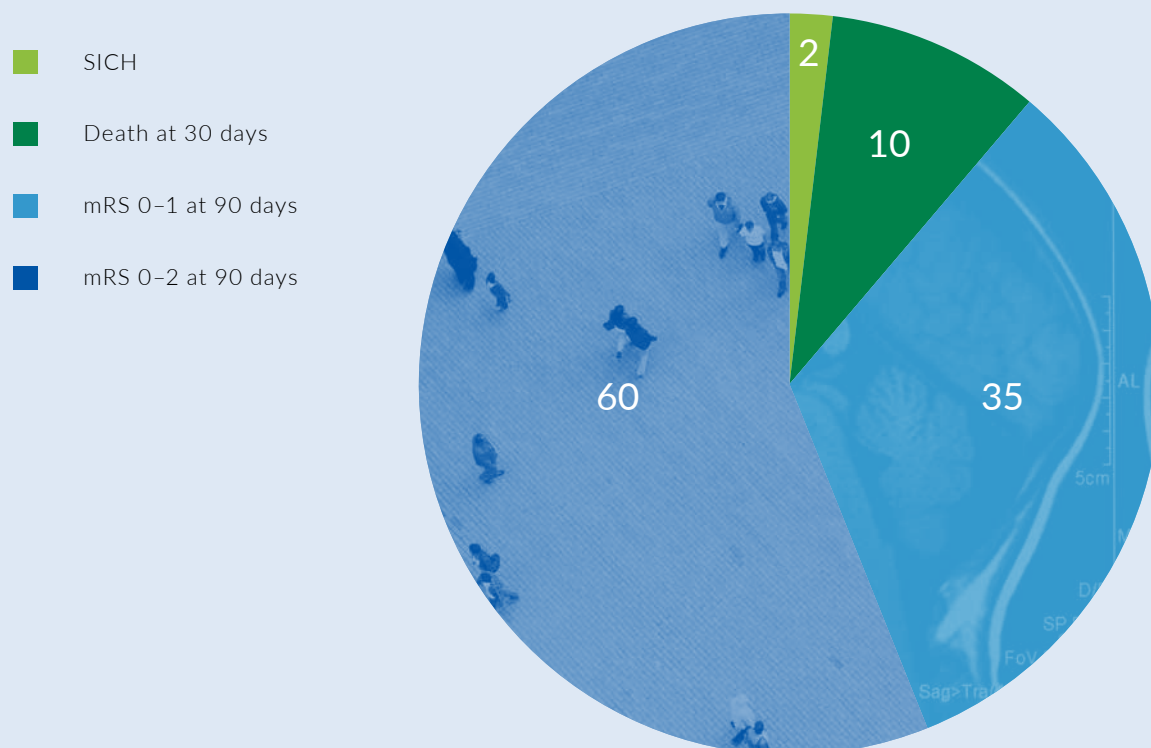
### Getting results

Among the core measures, OHSU had strong performance in 2016. No patients in the Get With The Guidelines population experienced SICH after tPA administration. There were also no SICHs among patients after intra-arterial tPA or thrombectomy. We administered nimodipine to 97.4 percent of SAH patients, well above the national average for Comprehensive Stroke Centers. We also performed above the national average in revascularization success with 96.6 percent of our patients having a TICl score of 2b or greater.

### mRS scores

- 0 = No symptoms
  - 1 = Symptoms, but no significant disability
  - 2 = Slight disability
- Visit [www.strokecenter.org](http://www.strokecenter.org) for the full modified Rankin Scale.

### Selected Treatment Outcomes for Patients Treated at OHSU Stroke Program, January–December 2016



This graph shows outcomes for patients treated with tissue plasminogen activator (tPA) at the OHSU Stroke Program or other centers who were subsequently treated and hospitalized at OHSU.

**KEY:** SICH = Symptomatic intracerebral hemorrhage, mRS = Modified Rankin Scale (the Rankin Scale is the most commonly used measure of function for stroke clinical trials).

## Additional services and information

### Cardiac causes of stroke

While cerebral vessels are often the anticipated cause, it is important to remember that cardiac emboli can cause strokes. Research now shows that patients may need monitoring for longer than previously thought in order to detect atrial fibrillation, which can wax, wane and be difficult to detect. Current trials in this area include finding the optimal medical therapy for patients with stroke of unknown etiology, and learning which patients are developing atrial fibrillation or are at risk from it.

### Neurosciences critical care

Our Neurosciences Intensive Care Unit is the cornerstone of a well-integrated and cohesive program for the treatment of critically ill patients with neurological conditions. Established in 2006, we are the only Neurosciences ICU in Oregon to offer 24/7 coverage by nationally recognized neurocritical care specialists. Additionally, we offer a Neurohospitalist Program that provides specialized neurologic care for inpatients that do not require the ICU.

The program provides exceptional critical care nurses with training and expertise in neurocritical care, and our advanced 24/7 neuromonitoring includes:

- Video electroencephalography (EEG)
- Intracranial pressure monitoring

### Traveling Continuing Medical Education (CME)

Our team is pleased to provide relevant education to fellow health care professionals; one way we do so is through our Traveling CME courses. These one-hour, CME-accredited sessions are facilitated by OHSU physicians and may take place at your clinic, allowing for required education credits to be earned in the convenience of your own offices. While we offer a wide range of neuroscience topics, our cerebrovascular offerings include courses on a variety of subjects from aneurysm to stroke.

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To learn more, please contact Dina Girgenti-Iida, provider relations manager, by phone at 503-494-6535 or by email at [girgenti@ohsu.edu](mailto:girgenti@ohsu.edu).

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### Research clinical trials

OHSU is a national leader in clinical trials for stroke and other cerebrovascular conditions. OHSU researchers have led stroke prevention clinical trials for over 35 years. Here are some recent results:

- A recent trial of patients with a narrowed vessel in the brain, compared to similar patients seen 10 years ago, showed that medical treatment cut stroke rates in half compared to the past.<sup>2,3</sup>
- A trial of stenting versus medical therapy showed that patients who received stents had more complications in the first 30 days after treatment, and no long-term benefit. However, the aggressive medical management strategy was shown to help prevent strokes. This method included lipid management, two antiplatelet medications and lifestyle modifications such as diet and exercise, in conjunction with frequent oversight.<sup>2</sup>

- Asymptomatic patients with carotid stenosis who have not had a stroke or TIA are now being studied in the CREST-2 trial. Previous studies showed an advantage for endarterectomy, but the benefits were not outstandingly different. We are currently comparing medical therapy to endarterectomy and stenting because we think these patients may do sufficiently well on medical therapy to prevent stroke or TIA.

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To learn more about cerebrovascular clinical trials, visit [www.ohsu.edu/cerebrotrials](http://www.ohsu.edu/cerebrotrials).

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Our neurointerventional team has a reputation for leading the practice of interventional neuroradiology, and the team continues to be instrumental in clinical trials investigating emerging state-of-the-art techniques and devices used to treat brain aneurysms.



### Virtual stroke clinics

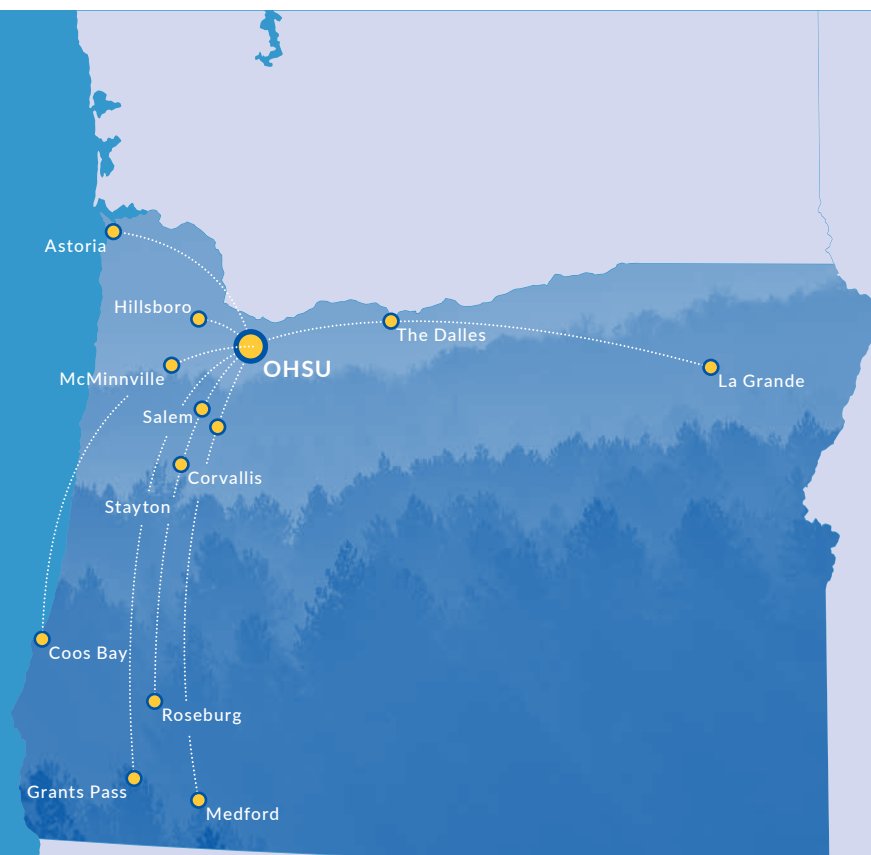
The OHSU Stroke Program has several satellite telehealth centers for follow-up care and research studies. Patients meet with OHSU specialists virtually at local clinics with the assistance of the clinic's care team.

### OHSU's Telestroke Program

The OHSU Stroke Program brings expert stroke care to centers around the state (including 12 regional hospitals), making expert stroke consultation available in most Oregon communities. A board-certified stroke neurologist or neurosurgeon is available to consult and examine patients 24/7.

Since the Telestroke Program's inception in 2010, OHSU specialists have performed more than 1,200 telestroke consults. On average, 60 percent of patients remain in their home communities, and an estimated \$11 million has been saved from averted patient transports.

Patients who truly need transfer to a comprehensive stroke center are also identified as quickly as possible by telemedicine — essential to treating such a time-sensitive condition. The specialist who provided the telemedicine consult meets the patient and family on arrival at OHSU and remains the attending physician during their stay, providing continuity of care and helping mitigate stress.





### Telestroke house calls

Many stroke patients are immobile, so OHSU stroke specialists make virtual house calls. Through a secure internet link, patients or caregivers connect with the physician for follow-up or clinical trial visits. The goal is to provide the full resources of an academic medical center to every patient and make care as convenient as possible.

### Telestroke follow-up for long-term care and skilled nursing facilities

Neurology and neurosurgery specialists care for stroke patients even at their long-term care facility using the OHSU Telehealth Network. Secure telehealth video links bring OHSU stroke and other experts directly to recovering patients at Vibra Specialty Hospital, Oregon's largest long-term acute care facility, and numerous skilled nursing facilities around the state.



## Our multidisciplinary team

Providing outstanding care for cerebrovascular conditions requires a highly trained team. The OHSU team includes neurologists, interventional neuroradiologists, neurosurgeons, neurointensivists and rehabilitation specialists.

### Diagnostic neuroradiologists



**James Anderson, M.D.**

**Academic and clinical appointments:** Professor; chief of neuroradiology; program director, radiology residency education

**Patient care emphasis:** Diagnostic neuroradiology



**Ramon Barajas, M.D.**

**Academic appointment:** Assistant professor

**Patient care emphasis:** Diagnostic neuroradiology



**Bronwyn Hamilton, M.D.**

**Academic and clinical appointments:** Professor; director, head and neck imaging

**Patient care emphasis:** Diagnostic neuroradiology



**David Pettersson, M.D.**

**Academic appointment:** Assistant professor

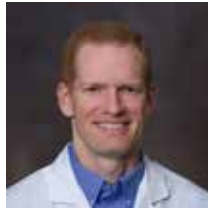
**Patient care emphasis:** Diagnostic neuroradiology



**Vaishali Phalke, M.D.**

**Academic appointment:** Associate professor

**Patient care emphasis:** Diagnostic neuroradiology



**Jeffrey Pollock, M.D.**

**Academic and clinical appointments:** Associate professor; director, Neuroradiology Fellowship Program; director, MR imaging

**Patient care emphasis:** Diagnostic neuroradiology



**João Prola, M.D.**

**Academic appointment:** Assistant professor

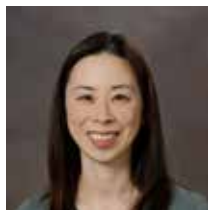
**Patient care emphasis:** Diagnostic neuroradiology



**Louis Riccelli, M.D.**

**Academic and clinical appointments:** Associate professor; director, Center for Health & Healing imaging

**Patient care emphasis:** Diagnostic neuroradiology



**Elizabeth Yutan, M.D.**

**Academic appointment:** Associate professor

**Patient care emphasis:** Diagnostic neuroradiology

### **Interventional neuroradiologists**



**Gary Nesbit, M.D.**

**Academic appointment:** Associate professor

**Patient care emphasis:** Diagnostic radiology

**Research interests:** Innovative imaging; new therapeutic techniques in acute stroke; intracranial atheromatous disease, cerebral aneurysms and arteriovenous malformations, including diffusion/perfusion imaging and magnetic resonance angiography (MRA) of atherosclerosis and aneurysms



**Ryan Priest, M.D.**

**Academic and clinical appointments:** Assistant professor; director, interventional neuroradiology

**Patient care emphasis:** Complex brain aneurysm treatment, brain arteriovenous malformations, dural arteriovenous fistulae, carotid artery stenosis and intracranial atheromatous disease

**Research interests:** Treatment of hemorrhagic and ischemic stroke

## Neurointensivists



**Julia Durrant, M.D.**

**Academic appointment:** Assistant professor

**Patient care emphasis:** Neurocritical care, traumatic brain injury, stroke and hypothermia after cardiac arrest

**Research interests:** Critical care management of post-anoxic brain injury from cardiac arrest, neurological prognostication



**Holly Hinson, M.D., M.C.R.**

**Academic appointment:** Assistant professor

**Patient care emphasis:** Traumatic brain injury, subarachnoid hemorrhage, stroke

**Research interests:** Traumatic brain injury, subarachnoid hemorrhage, autonomic dysfunction



**Tarvez Tucker, M.D.**

**Academic appointment:** Professor

**Patient care emphasis:** Neurocritical care, traumatic brain injury, headache and pain management and hypothermia after cardiac arrest



**Kamila Vagnerova, M.D.**

**Academic appointment:** Assistant professor

**Patient care emphasis:** Neurocritical care

## Neurologists



### **Hormozd Bozorgchami, M.D.**

**Academic appointment:** Assistant professor

**Patient care emphasis:** Ischemic stroke, cerebral atheromatous disease, carotid artery stenosis, intracranial stenosis, cerebral hemorrhage, cerebral aneurysms

**Research interests:** Acute ischemic stroke therapies



### **Wayne Clark, M.D.**

**Academic and professional appointments:** Professor; director, OHSU Stroke Program

**Patient care emphasis:** Acute treatment of stroke, including the investigation of new potential stroke therapies

**Research interests:** Inflammatory response in stroke, therapeutic potential of antioxidants



### **Helmi Lutsep, M.D.**

**Academic and professional appointments:** Professor; associate director, OHSU Stroke Program; chief of neurology, VA Portland Health Care System

**Patient care emphasis:** Stroke prevention, acute stroke treatment

**Research interests:** Stroke prevention, acute stroke treatment, stroke rehabilitation

## Neurosurgeons



### **Justin Cetas, M.D., Ph.D.**

**Academic and clinical appointments:** Associate professor; director, Neurological Surgery Residency Program; chief of neurosurgery, VA Portland Health Care System

**Patient care emphasis:** Pituitary, skull base and vascular disorders

**Research interests:** Effects of subarachnoid hemorrhage on the brainstem and central nervous system



### **Aclan Dogan, M.D.**

**Academic and professional appointments:** Associate professor; division head

**Patient care emphasis:** Cerebrovascular surgery, interventional neuroradiology, skull base neurological surgery

### Nurse practitioner



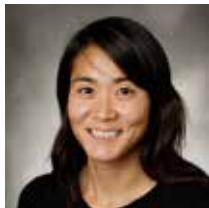
**Rebecca Garcia, M.N., F.N.P.-B.C., A.G.A.C.N.P.-C.**

**Academic appointment:** Instructor

**Patient care emphasis:** Neuroradiology, acute stroke and cerebral aneurysm

**Research interests:** Chronic headaches after subarachnoid hemorrhage, cerebral endovascular and stroke treatments, devices and techniques

### Physician assistants



**Dara Ono, P.A.-C.**

**Academic appointment:** Instructor

**Patient care emphasis:** Skull base surgery



**Janette Remling, P.A.-C.**

**Academic appointment:** Instructor

**Patient care emphasis:** Cerebrovascular and skull base surgery



**Katherine Thompson, P.A.-C., M.P.T.**

**Academic appointment:** Instructor

**Patient care emphasis:** Neurosurgery and spinal surgery

### Stroke Program Coordinator



**Noah Jacobson**

### Rehabilitation therapists

Anne-Marie Banasky, O.T., C.H.T.

Maggie Taylor Gallagher, M.P.T.

Shipla Joshi, D.P.T.

Kittima Leelaamornvichet, D.P.T.

Jeffrey Schlimgen, P.T., N.C.S.

Andrea Serdar, P.T., N.C.S.

Marvin Smith, D.P.T.

Jenny Wilhelm, P.T., D.P.T., N.C.S.



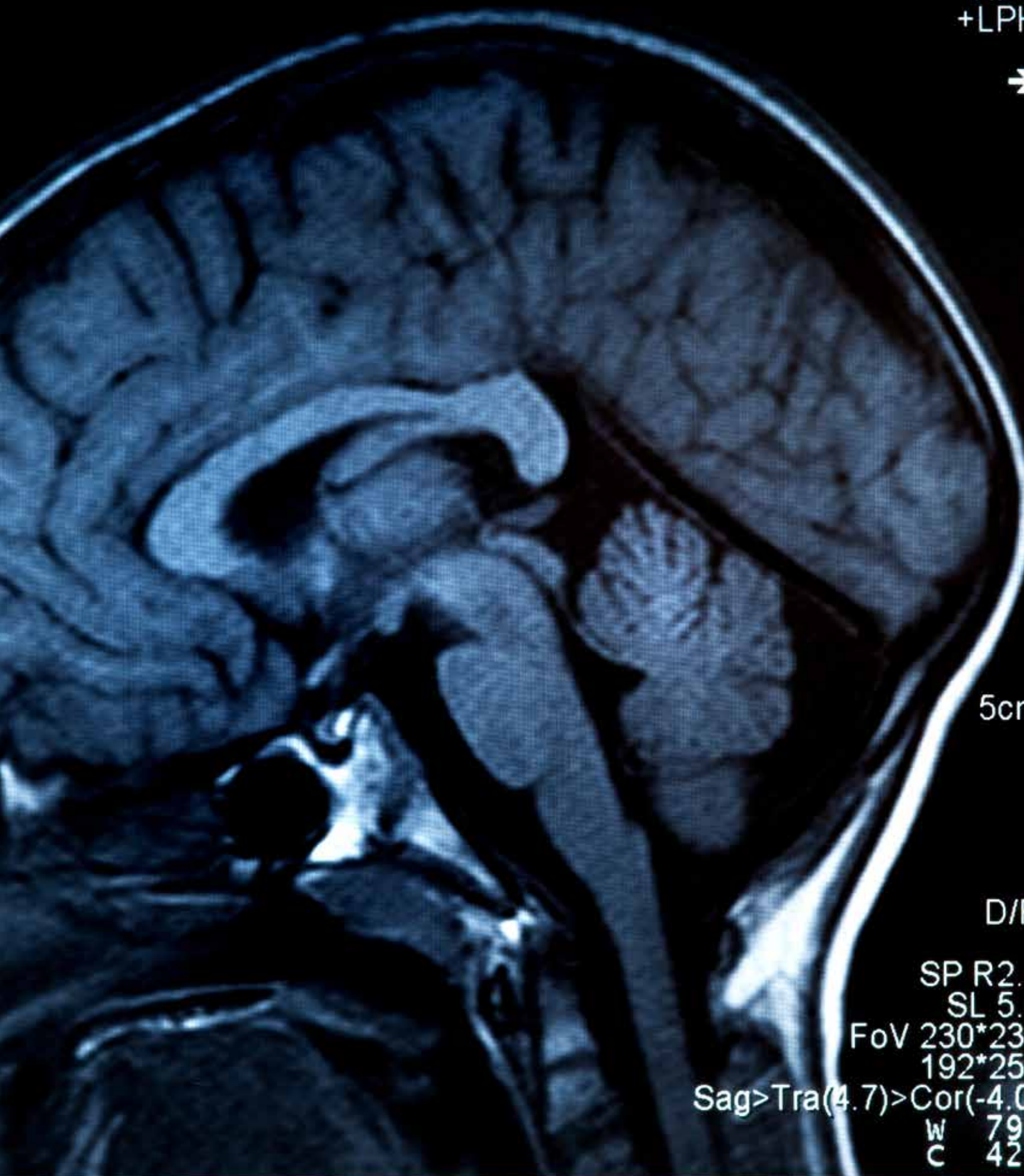


## References

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2. Derdeyn CP, Chimowitz MI, Lynn MJ et al. Aggressive medical treatment with or without stenting in high-risk patients with intracranial artery stenosis (SAMMPRIS): the final results of a randomised trial. *The Lancet* 2014;383:333-341.
3. Chimowitz MI, Lynn MJ, Howlett-Smith H, et al. Comparison of warfarin and aspirin for symptomatic intracranial arterial stenosis. *N Engl J Med* 2005; 352:1305-1316.

HLP

HOSPITAL  
Symphon  
MR 2002E  
HFS  
+LPH



5cm

D/I

SP R2.  
SL 5.  
FoV 230\*23  
192\*25  
Sag>Tra(4.7)>Cor(-4.0  
W 79  
C 42



To refer a patient or consult with our team,

please call 503-494-4567

or toll-free 800-245-6478

fax 503-346-6854

For acute stroke patient transfers to OHSU,  
please call the Transfer Center at 503-494-7000.

**OHSU Brain Institute**

3181 S.W. Sam Jackson Park Road

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[www.ohsubrain.com](http://www.ohsubrain.com)

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