PALMETTO HEALTH • Vol. 1 Issue 2 Autumn 2015

Neuroscience Journal

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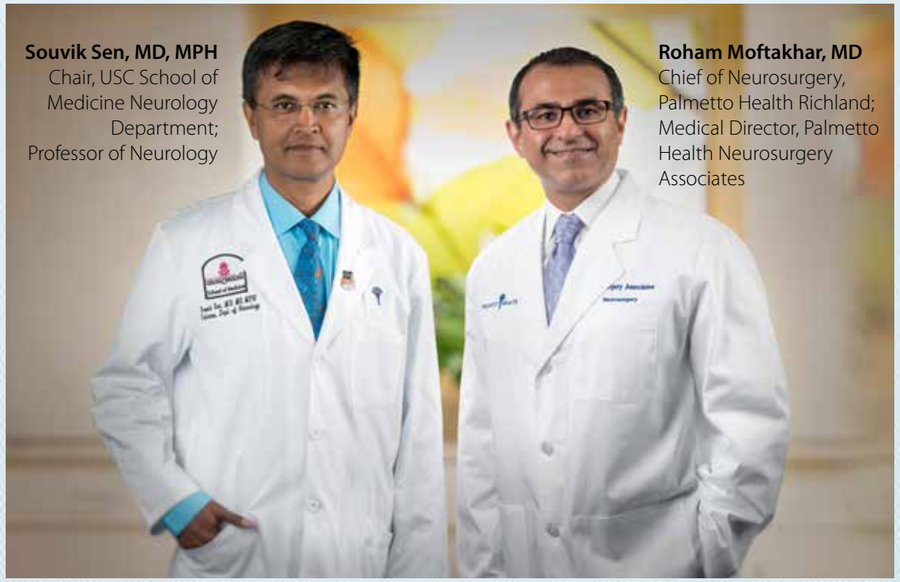
Palmetto Health's "4-BRAIN" phone line for emergent neurosurgical transfers pg. 3

As physician co-leaders of Palmetto Health's neuroscience service,

we share a vision to provide the most advanced neurology and neurological surgery treatments available to the residents of South Carolina. We are excited to share this edition of our neuroscience journal featuring information about Deep Brain Stimulation, the most advanced treatment option for the nearly one million Americans suffering from Parkinson's Disease and now available at Palmetto Health.



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Palmetto Health's "4-BRAIN" phone line for neurosurgical transfers– *Because seconds matter.*

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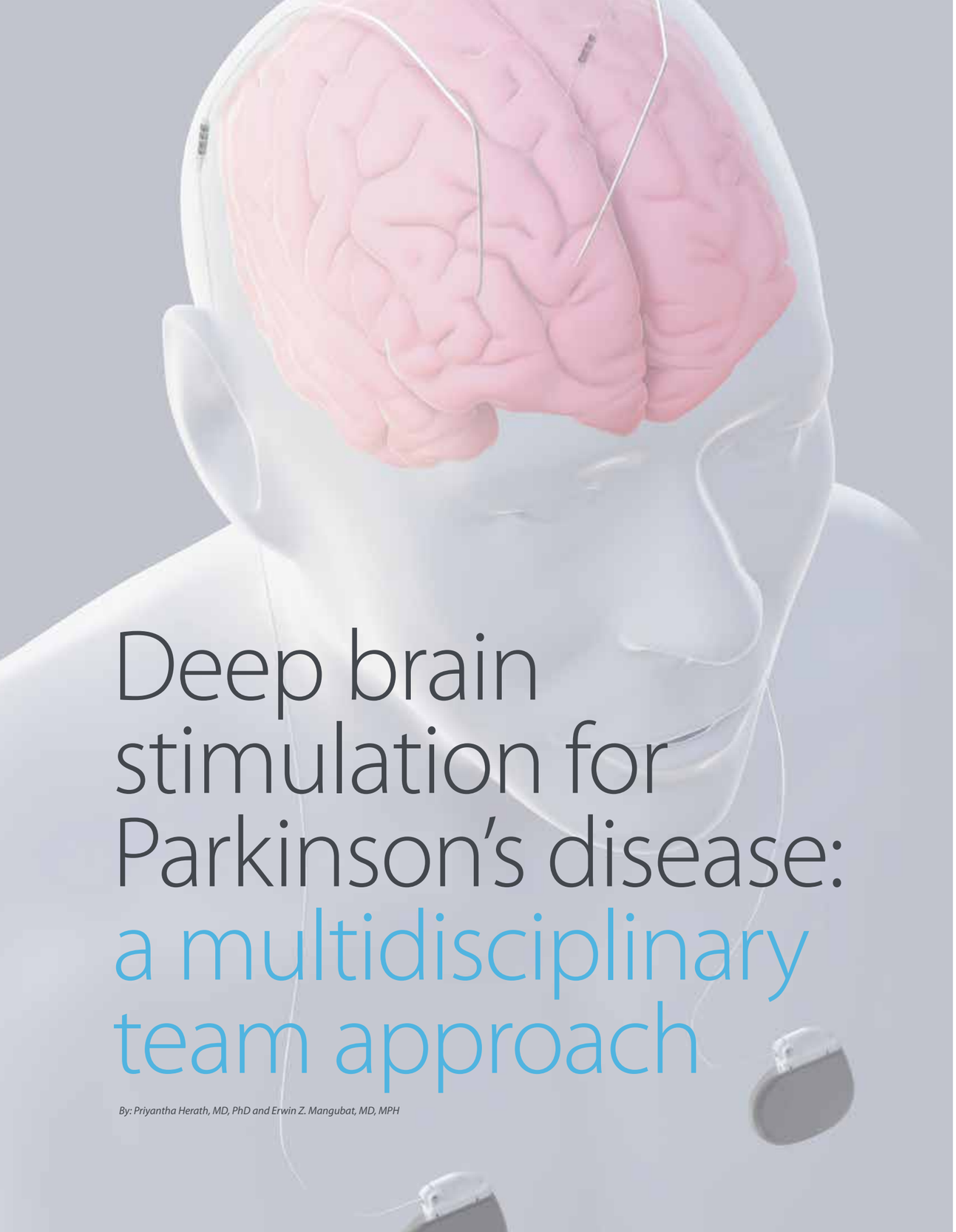
Studies have shown that one of the challenges faced by emergency room providers and referring physicians is fast and efficient access to neurological and neurosurgical physicians in tertiary medical centers. Palmetto Health's 4-BRAIN line allows emergency room providers and referring physicians to speak directly with a neurosurgeon or neurologist without going through an operator or long waits on the phone. Neurological problems that the 4-BRAIN line may be used for include intracerebral hemorrhages, subarachnoid hemorrhage, aneurysms, vascular malformations and brain tumors. The 4-BRAIN line is answered 24 hours a day, seven days a week.

Call 844-64-BRAIN (27246) for emergent neurosurgical transfers.



Deep brain stimulation for Parkinson's disease: a multidisciplinary team approach

By: Priyantha Herath, MD, PhD and Erwin Z. Mangubat, MD, MPH

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized pathologically by loss of dopaminergic neurons in the substantia niagra pars compacta that affects 0.3 percent of the general population and 1 percent of the population over the age of 65.[1] Although PD becomes more common as age increases, early-onset PD may occur in patients between the age of 21 and 40 years.[2] Pathophysiologically, the effect of dopaminergic neurons results in abnormal neuronal oscillatory and synchronous activity between the subtalamic nucleus, globus pallidus pars interna, and cerebral cortex.[3] This translates into the clinical findings of bradykinesia, rigidity, and tremors, as well as gait impairment in the motor domain. Hidden underneath these, there are a multitude of non-motor symptoms. These include sleep disorders, autonomic symptoms, pain, gastrointestinal symptoms, depression/anxiety, apathy, psychiatric disorders, behavioral changes, psychosis, and dementia. In addition, social isolation, financial burden, and domestic issues contribute to the already difficult situation. In addition to the motor difficulties, these non-motor symptoms have a major impact on quality of life (QoL). Because of this, PD is now regarded as a vastly more complicated, multidimensional disease. The severity of PD at a given time point is quantified using measures such as the Unified PD Rating Scale (UPDRS), which includes both patient reported and clinician evaluated elements.

The mainstay of treatment is medical therapy, with the primary goal of either elevating the level of dopamine in the brain (such as with carbidopa/levodopa) and/or prolonging the action of dopamine that is present.[4,5] Several drugs are available that can effectively treat the symptoms of the disease, but long-term medical management is often complicated by the appearance of levodopa-induced motor complications, leading to rapid changes between periods of severe akinesia and periods of mobility that may be accompanied by troublesome hyperkinesias.[6] Dopamine agonsists,[6] amantadine, catechol O-methyltransferase (COMT) inhibitors,[6] and other drugs can effectively improve mobility and reduce dyskinesias initially but typically fail after several years.[7] In the course of the disease, about 50 percent of patients will develop marked motor "on-off" fluctuations and drug-induced dyskinesias after five years of medical treatment.[8]

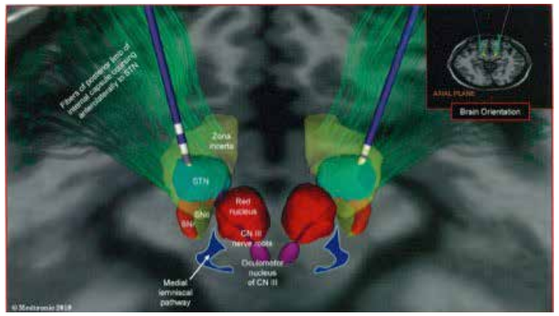
Because many patients develop complications of medical therapy after 5-15 years of treatment with these agents that include motor fluctuations, dyskinesia, and intolerance of increasing amounts of medications required owing to progression of disease and worsening PD symptoms, it is at this stage of PD that most experts advocate deep brain stimulation (DBS) for *properly selected patients*.[9-11]

Deep brain stimulation for Parkinson's disease

The modern era of DBS began in 1987 with the pioneering work by Benabid et al.[12] on the treatment of Parkinson's disease (PD). The discovery that electrical stimulation of functional targets, such as the subthalamic nucleus (STN), ventral intermediate nucleus (Vim), and globus pallidus internus (Gpi), was able to mimic (in a reversible and adjustable manner) a lesion-like effect has revived the use of functional neurosurgery for movement disorders.[13] DBS was approved by the US Food and Drug Administration as a treatment for ET in 1997, PD in 2002, primary dystonia in 2003, and OCD in 2009.

Although the exact mechanism of action of DBS is not known, it has both excitatory and inhibitory local effects, as well as widespread network influence, which together can result in symptomatic improvement in a particular disease.[14-18] Hyperactivity of the subthalamic nucleus (STN) and globus pallidus internus (GPi) is substantiated to be part of the pathophysiological mechanism of PD,[19] making them the most commonly targeted sites for DBS in PD.

Prior to the 1990s, the mainstay of surgical treatment for movement disorders were lesioning procedures, which involved creating a permanent destructive lesion in a specific brain target believed to be involved in the pathophysiology of the motor symptoms. Although clinically effective, these procedures were destructive, irreversible, and, in many cases, resulted in higher incidence of complications (including difficulties with speech and cognition) when performed bilaterally.[20,21] DBS became preferable to lesioning because it is nondestructive and adjustable.



3D reconstruction of bilateral DBS leads into the subthalamic nuclei (STN). (SNc = substantia nigra pars compacta; SNr = substantia nigra pars reticulate; CN III = cranial nerve III)

Practitioners are able to augment several stimulation parameters, including the location, size, intensity, and, even to a certain degree, the shape of the stimulating current field (Figure).

Surgically, DBS involves use of an implanted electronic device used to modulate the neuronal activity in a particular brain region or circuit. One or two electrodes or "leads" are placed in a specific target in the brain using various stereotactic neurosurgical techniques. The leads are connected to an internal pulse generator (IPG), which resides under the skin, typically in the chest, and contains the electronics that generate the simulating pulses, as well as the battery that powers the system.

What we know

Deep brain stimulation for PD is offered to patients with medication refractory on-off fluctuations, dyskinesia, or tremor. These patients may be selected as candidates following an *extensive interdisciplinary screening*. The screening aims to elucidate which features of PD are most responsive to dopaminergic therapy (responsive features tend to have the best response to DBS, with the exceptions of tremor, dyskinesia, and motor fluctuations), it identifies cognitive and psychiatric issues, and assesses co-morbidities that may increase the risk or limit the effectiveness of therapy.[22] Most practitioners agree that when medication intervals become very close in time (within 2-3 hours), and on-off fluctuations, dyskinesia or tremor emerge and are difficult to control, then it is time to at least consider the use of DBS therapy. Several studies revealed an advantage of DBS over medical therapy including the UK PD surge trial,[23] the VA Cooperative Study,[24] and the NEJM Quality of Life Study.[25]

Vital for increasing acceptance of DBS is a prospective randomized-pairs trial published in the New England Journal of Medicine, which found DBS to be significantly more effective than medical management of patients with PD at six-month follow-up.[25] A randomized-pairs trial of 156 patients with advanced PD and severe motor symptoms demonstrated significant improvements in both the quality of life measure Parkinson Disease Questionnaire (PDQ)-39 (p=0.02) and motor UPDRS III (p <0.001). Also, in a large ongoing, randomized, open-label trial, Williams et al.[23] evaluated 366 patients randomly assigned to receive immediate surgery and best medical therapy (n=183) or best medical therapy alone (n=183). At one year, the mean improvement in PDQ-39 summary index score compared with baseline was 5.0 points in the surgery group and 0.3 points in the medical therapy group (p=0.001). The difference in mean change in PDQ-39 score in the mobility domain was -7.5 (p=0.004). Thus, the combination of surgery and best medical therapy improved patient self-reported quality of life more than best medical therapy alone in patients with advanced Parkinson's disease.

Therapy, best candidates, and when to consider DBS

Good candidates for DBS are those who have fair dopaminergic response while showing "on-off" fluctuations, dyskinesias, and medication-resistant tremor with reasonable cognitive function.[26] Most advocate at least a 25-30 percent improvement in the UPDRS Part III (clinician scored motor examination) between the off and the on medication state.[10] Other factors that should be considered include confidence in the diagnosis, minimal presence of non-motor symptoms (particularly cognitive decline and depression), minimal medical co-morbidities, age, and most importantly, realistic expectations on the part of all parties involved, as well as reasonable social support, and the ability to handle the responsibilities of a complex therapy. Proper diagnosis by a trained movement disorder neurologist is essential, particularly to make a distinction between idiopathic PD and atypical parkinsonism that is seen in other neurologic disorders, such as progressive supranuclear palsy and corticobasal degeneration. In idiopathic PD, dopaminergic therapy and DBS are generally effective, while in the atypical syndromes they are not.[27-29] Many centers perform on medication/off medication UPDRS III clinical examinations, as well as full neuropsychological evaluations to assess many of these factors before deciding to proceed with surgery.

Typically, levodopa-responsive symptoms, dyskinesias, tremor and "on-off" fluctuations are most likely to improve with DBS, remaining stable for at least four years, whereas impairments in speech, balance, gait, and cognition are less likely to improve and may in some cases worsen post-operatively.[30-32] The most commonly observed mood effect following DBS surgery has been a slight improvement in depressive symptoms.

DBS of the STN does not reduce overall cognition or affectivity, although there is a selective decrease in frontal cognitive functions in patients after the treatment. These changes do not affect improvements in quality of life.[33] Worsening of non-motor symptoms, especially in the neuropsychological and psychiatric domains, may occur, likely transient in the immediate post-operative period after STN DBS, and possibly related to the changes in dopamine replacement therapies or the surgery itself.

Patient commitment and patient-perceived benefits must also be carefully considered when deciding whether or not to perform surgery at an earlier stage of PD.[34] Although DBS does improve a number of motor-related symptoms and has been proven to increase QoL, it is largely important that practitioners convey and patients understand that DBS is not a cure nor does it provide any disease-modifying effects. This is essential, as it is well established that unrealistic patient expectations are the most important reason behind "DBS failures".

There has been a recent change in thinking regarding timing of DBS surgery in PD. Current practice dictates that DBS not be considered until patients progress to the point where they start to develop either motor fluctuations and/or dyskinesias. However, by this point, many patients have already experienced significant decline in quality of life, social impairment, and interruption of professional activity if they are still working. Some clinicians advocating surgery earlier in the disease course, when patients are more dopamine responsive and non-motor symptoms have not yet become significant.[35] The clinical trial (EARLYSTIM) in 251 patients demonstrated data showing that quality of life scores were higher when DBS was done in earlier stage PD patients.[36]

Safety

In general, DBS is a relatively safe approach associated with an encouragingly low rate of adverse effects. Adverse effects of DBS consist of a wide variety of acute or chronic neurological and neurophsychological complications, such as those related to surgery, hardware, and stimulation. The major surgery-related risk is intracranial hemorrhage with an incidence of ~2-3 percent. Most hemorrhages are asymptomatic, observed only on postoperative brain imaging.[37-38] Hardware-related complications include hardware migration, disconnection, or mechanical malfunction, although the risk of such events is <2%.[39] Stimulation-related adverse effects include muscle contractions, dysarthria, ocular deviations, tremor, dyskinesia, headache, pain, and paresthesias, which are very useful during intraoperative target exploration and can often be relieved by adjustment of stimulation parameters or cessation of therapy.[40] Psychiatric events like mania, depression, apathy, panic, impulsivity, anxiety, hallucinations, and even suicidal ideation, are probably multifactorial by medication changes, neuronal plasticity following DBS, adaptation difficulties, and dramatic sociofamilial modification induced by the motor effects of DBS. These patients should be screened and managed by a multidisciplinary approach.[41]

Palmetto Health and USC School of Medicine multidisciplinary and interdisciplinary approach

As the subspecialty field of Movement Disorders became established over the last 30 years or so, this has changed somewhat. At present, there are estimated 250-300 fellowship trained Movement disorders specialist neurologists in the country. As in many other subspecialties in medicine, there is data

to show that PD patients also receive much better care and have much better outcomes if treated by specialists. For many decades, it was customary that a non-specialist would take care of PD patients with almost a nihilistic attitude.

Patient selection for DBS should utilize a multidisciplinary team. In the last several years, this trend of moving PD care from internists and general neurologists to Parkinson specialists has evolved even further. It is now well recognized that, spearheaded by a trained movement disorders specialist, the best quality of care to the Parkinson patients are provided by a team of specialists. An adequate team would include a specialist neurologist, a functional neurosurgeon who is trained in deep brain stimulation surgery, neuropsychologist, psychiatrist, physiatrist, physical and occupational therapists trained in PD, speech therapists, social workers, dietitian, DBS nurse/PD nurse coordinator, and a research coordinator. Candidacy also should be determined based on an individual patient's desired commitment, expectations, and goals.

At Palmetto Health and USC School of Medicine we now have several of these specialists who work in tandem to treat Parkinson's patients. To the best of our knowledge, this is the first such program in the state of South Carolina. In this setting we have established a multidisciplinary and interdisciplinary team with the shared goal of addressing the neurologic, physical, psychiatric, and socio-economic needs such patients require. For example, we are able to offer the services of non-physicians, including several certified Lee Silverman Voice Treatment Big (LSVT-BIG) physical and occupational therapists for gait and balance training, speech therapists with LSVT certification, a social work intern, and a neuropsychologist, to our Parkinson's patients.

Conclusion

Parkinson's disease is a progressive neurodegenerative disorder, which leads to poor quality of life. Medical management helps a great deal; however, in some cases fails after a number of years. Deep brain stimulation has been proven to be an effective and safe surgical therapy in alleviating many of the motor-related symptoms. At Palmetto Health and USC School of Medicine we offer a multi-disciplinary and inter-disciplinary team to those suffering from Parkinson's disease. ◄

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Meet our deep brain stimulation team

Priyantha Herath, MD, PhD

Assistant Professor of Neurology, USC School of Medicine Department of Neurology

Dr. Herath received his medical degree from the University of Peradeniya with Honors, and also earned a PhD in Neuroscience from the prestigious Nobel Institute of the Karolinska Institute in Stockholm, Sweden. His work focused on in vivo brain imaging of humans involved in high level dual tasking. This work was followed by an internship in Psychiatry, and a residency in Neurology at the University of Pittsburgh Medical Center. He is board certified in Neurology.

Following residency, he was a Clinical Fellow at the National Institute of Health/NINDS, specializing in movement disorders. During this time he worked on in vivo MR spectroscopic imaging, in search for how some neurotransmitters might be turning over in adult human brains with movement disorders. This work remains one of his main scientific interests. Dr. Herath completed an advanced Fellowship in Movement disorders at the University of Maryland Baltimore. His research interests include how to study neurotransmitter turnover in adult human brains with movement disorders, and in adults who exercise.

Erwin Mangubat, MD, MPH

Palmetto Health Neurosurgery Associates

Dr. Mangubat received his medical degree from the University of Illinois at Chicago College of Medicine, and a master's in public health from the University of Illinois at Chicago School of Public Health. He completed his neurosurgery residency at Rush University Medical Center in Chicago, followed by an epilepsy and functional fellowship at the Swedish Neuroscience Institute in Seattle. He returned to Rush University Medical Center for his endovascular fellowship. Dr. Mangubat's interests include endovascular neurosurgery, as well as epilepsy and functional neurosurgery.

Accomplishments

X.M. Androulakis, MD

Amanda Cotter, X. M. Androulakis, Andrea Griffin, Karen Cartrett, Khosrow Heidari, Souvik Sen. (2015) Three-Year Trend in Emergency Medical Transportation System and Acute Stroke Thrombolysis Utilization in South Carolina. International Stroke Conference annual meeting. Abstract #3977

X. M. Androulakis (2015) A case of hemicranias continua: the role of repetitive chemical inhibition of sphenopalatine ganglion. American Headache Society meeting. Abstract #LBP02

McCausland Center (M-Fund) for new investigators. A prospective fMRI study on resting state brain activity in healthy subjects and in chronic migraine patients undergoing long term Sphenopalatine ganglion blockage. April 2015-June 2016

USC Aspire Grant. A prospective fMRI study on resting state brain activity in health subjects and in chronic migraine patients undergoing long term Sphenopalatine ganglion blockage. May 2015-August 2016

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Miroslav Cuturic, MD

Enroll-HD: A Prospective Study in a Global Huntington's Disease Cohort. September 2015.

Priyantha Herath, MD, PhD

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Sonal Mehta, MD

Vice-chief of staff, Neurology at Palmetto Health Richland. 2015

Abstract Reviewer, International Stroke Conference. 2015.

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Endovascular Treatment of Cerebral Sinus Thrombosis. Edgell RC, Wasay m, Drazin D, Mehta S, Borhani-Haghighi A. Neurointervention in the Medical Specialties, Current Clinical Neurology (2015) pp 125-136 (Springerlink)

Souvik Sen, MD, MS, MPH, FAHA

Herath, P, Hanayik T, Krebs K, Dennis L, Rorden C, Fridriksson J, Sen S*. Resting State Functional Connectivity and Thrombolysis Mediated Reperfusion in Acute Ischemic Stroke: A Pilot Study. J Neurol Disord 2015, 3:2.

PeRiodontal treatment to Eliminate Minority InEquality and Rural disparities in Stroke (PREMIERS) Role: PI Source: National Institute on Minority Health and Health Disparities (NIMHD) Grant Period: 2015-2019. Brief Description: This project proposes a randomized controlled trial that will evaluate an intervention (periodontal treatment) to reduce the risk for recurrent vascular events among ischemic stroke and transient ischemic attack (TIA) survivors.

NAVIGATE: Multicenter, randomized, double-blind, double-dummy, active comparator, event-driven, superiority phase III study of secondary prevention of stroke and prevention of systemic embolism in patients with a recent embolic stroke of undetermined source (ESUS), comparing Rivaroxaban 15mg once daily with Aspirin 100mg Role: Site PI Source: Bayer HealthCare AG Grant Period: 2015-2018

PROSPER: Patient Centered Research into Outcomes Stroke Patients Prefer and Effectiveness Research Role: Site PI Source: Duke – PCORI Grant Period: 2015-2016

Yedatore Swamy Venkatesh, MD, DM,FRCP (Edin), FAAN, FACP

Palmetto Health/USC Neurology Residency Program "Teaching Award" - June 2015

Roham Moftakhar, MD

Heiferman DM, Billingsley JT, Kasliwal MK, Johnson AK, Keigher KM, Frudit ME, Moftakhar R, Lopes DK. Use of flow-diverting stents as salvage treatment following failed stent-assisted embolization of intracranial aneurysms. J Neurointerv Surg. 2015 June 3. pii: neurintsurg-2015-011672. doi: 10.1136/neurintsurg-2015-011672. [Epub ahead of print] Review. PMID: 26041098 [PubMed - as supplied by publisher]

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Fax: 803-434-8326
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Department of Neurology
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Call 844-64-BRAIN (27246) for emergent neurosurgical transfers.

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PalmettoHealth.org 803-296-CARE (2273)

Our Vision: To be remembered by each patient as providing the care and compassion we want for our families and ourselves.