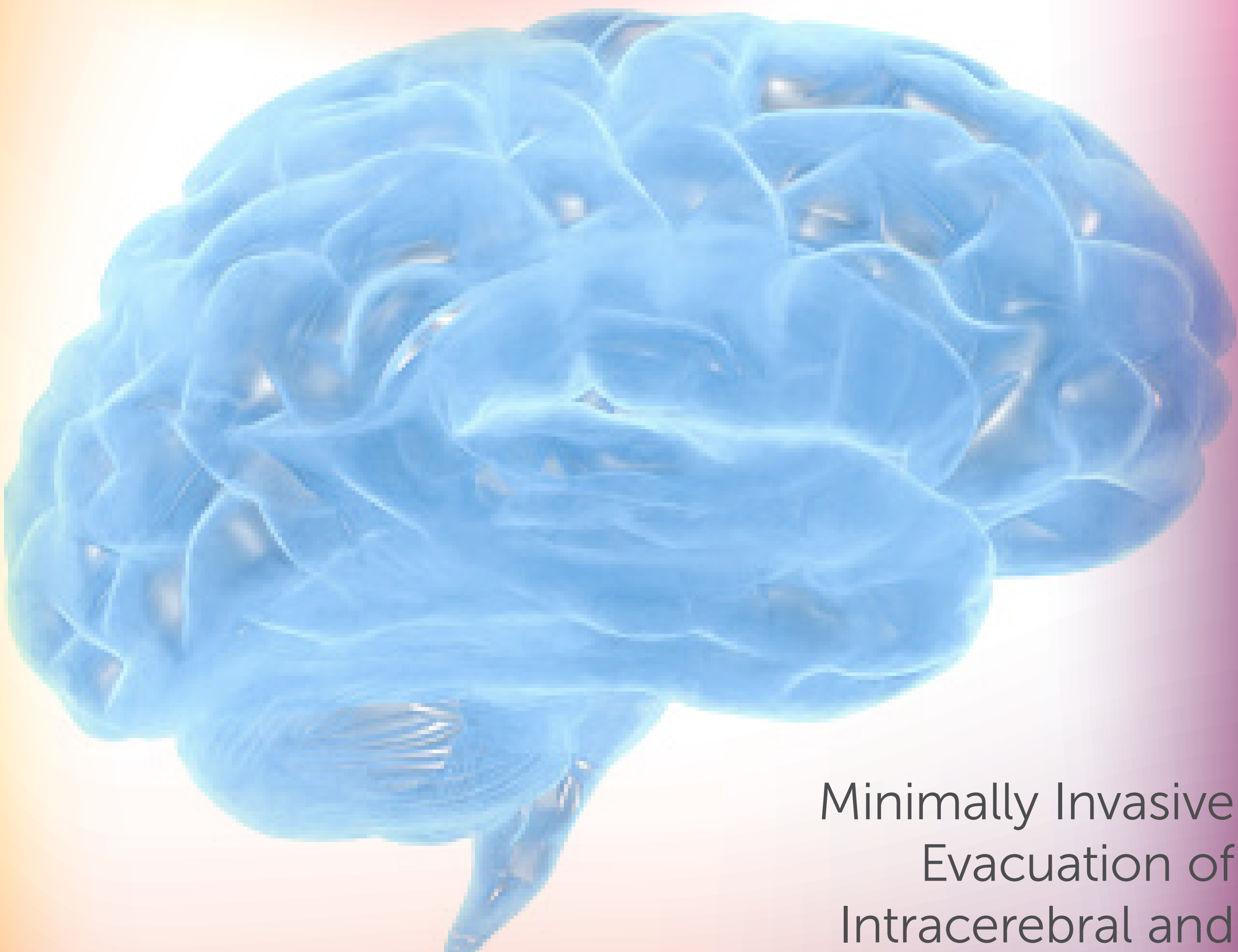
Prisma Health–Midlands ▪ Vol. 5 Issue 3 Summer 2019

Neuroscience Journal



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As physician co-leaders of Prisma Health–Midlands 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 latest edition of our neuroscience journal featuring a case report on minimally invasive evacuation of intracerebral and intraventricular hemorrhage, plus a summary of Dr. Julius Fridriksson's study on speech entrainment and its effects on patients with nonfluent aphasia.

Souvik Sen, MD, MS, MPH
Chair of Neurology,
Palmetto Health-USC Neurology

Professor of Neurology,
University of South Carolina School of Medicine

Roham Moftakhar, MD
Chief of Neurosurgery,
Prisma Health Richland Hospital

Medical Director,
Palmetto Health-USC Neurosurgery

Associate Professor of Clinical Surgery,
University of South Carolina School of Medicine

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Minimally Invasive Evacuation of Intracerebral and Intraventricular Hemorrhage

By Roham Moftakhar MD, Chief of Neurosurgery, Prisma Health–Midlands; Associate Professor of Surgery, University of South Carolina School of Medicine

Spontaneous intracerebral hemorrhage (ICH) combined with intraventricular hemorrhage (IVH) accounts for approximately 2 million strokes worldwide per year[1]. It is considered one of the deadliest subtypes of strokes, nearing about 50% mortality. Of the patients who survive, almost 60–88% are dependent on others for daily activities after six months[2]. Given the high morbidity and mortality of this disease process, surgical options for evacuation of ICH and IVH have been evaluated.

One of these randomized clinical trials is the MISTIE trial (minimally invasive plus rt-PA for ICH evacuation). The trial evaluated minimal catheter evacuation followed by thrombolysis with the aim of decreasing clot size to 15 ml or less and whether it would improve functional outcome in patients with ICH[3]. This was a randomized, controlled, open label, blinded endpoint phase 3 trial. Patients were enrolled with spontaneous, traumatic, supratentorial ICH of 30 ml or more. Patients were randomized to image guided MISTIE treatment, which was 1 mg of alteplase every 8 hours for up to nine doses, or standard medical treatment.

Primary outcome was good functional outcome defined as the proportion of patients who achieved mRS score of 0-3 at 365 days. Of the 506 patients randomized, 45% had achieved mRS score of 0-3 at 365 days in the MISTIE group and 41% had achieved the same in the standard treatment group. The conclusion of this study was that for moderate and large ICH, MISTIE did not improve the proportion of patients who achieved good response at 365 days after ICH. The criticism of this conclusion was that 62% of clots were deep seated in the basal ganglia and only 38% were lobar. As far as we know, evacuation of deep-seated clots is not beneficial. Furthermore, in the MISTIE group 58% of patients achieved the surgical aim of residual of less than 15 ml of hematoma compared to less than 1% in standard treatment group. Estimated all-cause mortality was significantly lower in the MISTIE group. Analysis of association between clot removal and functional outcome showed extent of removal was correlated with mRS score of 0-3. Also, the number of deaths in the MISTIE group was lower than in the standard treatment group. Finally, based on secondary analysis, mortality at 365 days appeared to be lower in the MISTIE group than in the standard treatment group and without an increase in the proportion of patients with severe disability.

With the results of MISTIE III being unconvincing, the benefit of minimally invasive evacuation of ICH is questionable. Furthermore, it raises the question of whether active evacuation of ICH with minimally invasive devices would be beneficial. Two trials, ENRICH (Early Minimally-Invasive Removal of Intracerebral Hemorrhage) sponsored by NICO Corporation and INVEST (Minimally Invasive Endoscopic Surgical Treatment with Apollo/Artemis in Patients with Brain Hemorrhage) sponsored by Penumbra Inc. are ongoing. Scaggiante et al[4] reported, in their meta-analysis of randomized controlled trials of minimally invasive surgery for ICH, that minimally invasive techniques decrease the rate of severe to moderate impairment and death. Also, patients who underwent earlier evacuation had better outcomes.

More studies are underway and will be needed to examine if active evacuation of ICH and IVH using minimally invasive devices is beneficial in terms of functional outcome.

Case

A 62 year old woman presented with sudden loss of consciousness. Patient was transferred to Prisma Health Richland Hospital where her Glasgow Coma Scale (GCS) was 3. CT scan of the head (Figure 1) demonstrated basal ganglia hemorrhage with extension to the ventricles. Upon arrival, external ventricular drain was placed. CT angiogram of brain was negative for aneurysm or vascular malformation. Six-hour repeat head CT was stable. Patient was taken to the operating room for minimally invasive evacuation of intraventricular hemorrhage and ICH using Artemis suction vibration device (Penumbra Inc.). Post-operative CT scan confirmed the evacuation of the ICH and IVH. Two external ventricular drains were left in at the time of surgery and weaned post-operatively. Patient was discharged from the hospital awake, alert, following commands and with weakness in the right arm. The patient did not require a ventriculoperitoneal (VP) shunt. ◀

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FIGURE 1 | Initial head CT of brain without contrast demonstrated left basal ganglia hemorrhage with extension into the ventricles

FIGURE 2 | Post-operative CT of the head without contrast demonstrates the successful evacuation of the intracerebral hemorrhage and the i
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Speech entrainment and its effects on patients with nonfluent aphasia

By Lynsey M. Keator, MA, CCC-SLP, PhD Student, Center for the Study of Aphasia Recovery (C-STAR), Department of Communication Sciences and Disorders, University of South Carolina

Julius Fridriksson, PhD, a professor in the Department of Communication Sciences and Disorders at the University of South Carolina, is internationally renowned for his research focused on cognitive and communication impairment in stroke. A UofSC Health Sciences Distinguished Professor and Endowed SmartState Chair, Dr. Frikdriksson directs the Center for the Study of Aphasia Recovery (C-STAR), a part of the Aphasia Laboratory, and co-directs the McCausland Center for Brain Imaging at Prisma Health Richland Hospital. C-STAR is a $11.1 million project funded by the National Institutes of Health aimed to improve aphasia treatment effectiveness and to identify patient factors that can be used to improve diagnosis of language impairment, guide aphasia treatment, and predict stroke prognosis.

Stroke is the leading cause of disability in the United States (Benjamin et al., 2017) and subsequently, a major public health concern. Approximately 20–30% of stroke survivors suffer from aphasia (Engelter et al., 2006; Laska, Hellblom, Murray, Kahan, & Arbin, 2001), a language disorder resulting from damage to the neural networks that support language processing. For 15% of these individuals, aphasia persists into the chronic stages of recovery (Wade, 1994) and it is estimated that there are approximately 2 million people living with stroke-induced aphasia in North America (Simmons-Mackie, 2018). Aphasia can vary in severity and type. For example, after a stroke, some patients may present with minimal verbal expression and may not understand spoken language, while others may present with a milder form of aphasia where they demonstrate difficulty retrieving specific words. Because aphasia affects all four domains of language: spoken language, auditory comprehension, reading and writing, it influences not only the ability to communicate with family and friends (Hemsley, G., Code, 1996), but drastically decreases education and employment opportunities resulting in poor quality of life (Franzén-Dahlin, Karlsson, Mejhert, & Laska, 2010; Hilari & Byng, 2009; Hilari, Wiggins, Roy, Byng, & Smith, 2003).

Speech-language pathologists (SLPs) are the primary health care providers involved in aphasia rehabilitation. Traditionally, SLPs rely on behavioral interventions to provide compensatory strategies for speech and language or alternatively, address the impairments directly through a variety of intervention models (Brady et al., 2016). Recent research in the field of aphasiology yield substantial evidence that aphasia rehabilitation yields positive outcomes, even into the chronic stages of recovery (more than 6 months post-stroke; Breitenstein et al., 2017; Nouwens & Visch-brink, 2015; Pulvermuller & Berthier, 2008).

Broca's aphasia, a common type of aphasia resulting from damage to anterior speech areas in the left hemisphere, is characterized by nonfluent spontaneous speech, comprised of short telegraphic utterances involving mostly substantive words (Brookshire, 2003). Though patients with this type of aphasia can improve with speech-language rehabilitation (Edmonds, L., Nadeau, S., Kiran, 2009; Fridriksson et al., 2009; Kendall et al., 2008; Kiran, S., Sandberg, 2011), these deficits often persist into the chronic stages and most patients never fully recover.

Unlike traditional models of speech and language therapy that prompt patients with nonfluent aphasia to produce speech (a task that is inherently difficult for them to do), Dr. Fridriksson and colleagues at the University of South Carolina highlight a new treatment model in which patients with aphasia watch and listen to a video of someone speaking (audio-visual speech) and are asked to mimic the speaker and to produce the words in unison with the speaker. This type of treatment focuses on speech perception tasks involving hearing speech and seeing the mouth of the speaker and is thought to activate the residual areas of the left hemisphere (Fridriksson et al., 2012). There is, of course, a few milliseconds delay as a patient follows along with the video but importantly, patients are not repeating the speech they see and hear, rather they are following along with the speech in real time to produce fluent speech.

In a TEDx Talk recorded in 2012, Dr. Fridriksson discusses speech entrainment and its effects on patients with nonfluent aphasia. This behavioral therapy, as described above, relies on an audio-visual model, to enhance speech production. In the video, Dr. Fridriksson presents a patient with severe, nonfluent aphasia who typically communicates using single words. When presented with the speech entrainment model however, this gentleman demonstrates fluent, coherent speech and reveals the greatest and most diverse productions since his stroke 22 years earlier. Dr. Fridriksson emphasizes that the results portrayed in the video are not limited to this gentleman who presents with a very severe, nonfluent aphasia. Rather, these exciting results extend to a number of study participants with nonfluent aphasia.

Results from a larger study investigating this therapy model are presented in a 2012 publication in Brain (Fridriksson et al., 2012). In the study, participants train with speech entrainment therapy for six weeks and three different conditions are considered: speech entrainment with audio and visual stimuli, speech

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entrainment with audio only, and spontaneous speech. A one-factor repeated-measures analysis of variance (ANOVA) with three levels revealed a main effect suggesting that speech performance differed among at least two conditions, $F(2,24) = 11.1 < P < 0.0004$. Post hoc analyses showed that speech entrainment-audio visual (mean = 66.04%, standard error (SE) = 4.36%) elicited a larger variety of words compared with both speech entrainment-audio only (mean = 40.79%, SE = 4.22%, $t(12) = 3.62$, $P < 0.004$) and spontaneous speech (mean = 29.99%, SE = 5%, $t(12) = 4.30$, $p < 0.001$). Severity of apraxia of speech was related to how much patients benefitted from speech entrainment (high ratings on the Apraxia Battery for Adults, suggesting more severe apraxia of speech were inversely related to how many more words patients were able to produce during the speech entrainment-audio visual condition compared with the spontaneous speech condition $F(1,11) = 7.97$, $P = 0.017$, $R2 = 0.42$).

These results suggest that patients with nonfluent aphasia improve speech production with speech entrainment training. Importantly, these results generalize to spontaneous speech production (for example, when the audio-visual stimulus is taken away) in patients with nonfluent aphasia. You can watch the TEDx Talk and learn more about Dr. Fridriksson's work in aphasia here: https://www.youtube.com/watch?v=Cy6S7aMmUYo&t=570s. ◄

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