

CURRENTS

News Magazine of the Neurocritical Care Society

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Note from the Editor



Dear Colleagues,

I want to welcome you to the final issue of *Currents* in 2018, the official quarterly news magazine of NCS. As we are approaching a new year, I would like to wish our readers happy holidays and express my genuine appreciation to our editorial board members and to everyone who participated in supporting the *Currents* spirit and advancing its exciting mission.

Over the last year, our *Currents* team has been working hard to grow this quarterly magazine nationally and internationally. In 2018, we built a thriving network of members who contributed significantly to the international sections of *Currents*. With the help of our outstanding managing editor, Alexa Schlosser, we reinvented the *Currents* electronic website design and made it more engaging, interactive and reader friendly, which increased our newsletter browsing traffic significantly. To check out the *Currents* website, go to currents.neurocriticalcare.org.

We started a research column with the help of Shraddha Mainali, Sara Hocker and Andrew Naidech from the NCS Research Operations Subcommittee to boost the research content of our newsletter. In addition, we expanded our editorial board to achieve the educational mission of this newsletter. Please join me in welcoming two new editorial board members:

- Editor of Ethics section: **Deepa Malaiyandi, MD**, who is an assistant professor of neurology at the University of Toledo, Ohio.
- Co-editor of NEWS Review section: **Sara Stern-Nezer, MD**, who is an assistant professor of Neurology at University of California, Irvine.

Our plan for 2019 is to continue this global newsletter success, keeping our content valuable, scientific and educational. Remember, it's all about teamwork, so please stay involved!

This issue of *Currents* has many international news articles that provide you with a panoramic view of the motivational growth of our specialty. Don't miss the opportunity to learn about Neurocritical Care in Singapore and Zambia, as well as the first neurocritical care unit in Abu Dhabi. Highlights from the Seventh International Hypothermia and Temperature Management Symposium in Sydney are also available.

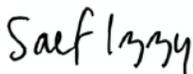
In addition to our regular columns, this issue of *Currents* features many motivating news articles that I highly recommend on topics such as the future of neurocritical care research article, growing mentorship within neurocritical care and caring for the post-procedure mechanical thrombectomy patient.

Don't miss out on the opportunity to learn the Road to Career Development Awards! We launched this new initiative to motivate our NCS members and boost the research section of our newsletter by featuring our society National Institute of Health career development grant awardees. In this issue, Lauren Koffman interviewed **Christopher Anderson**, from Massachusetts General Hospital, **Jonathan Elmer** from the University of Pittsburgh Medical Center, and **Raj Dhar** from Washington University, who told us about their research background and grant application experience, which I found very inspiring.

On the cover: The cover art was submitted by Lauren Koffman, DO, MS, a neurointensivist at Rush University Medical Center in Chicago. The view is along a path within Morton Arboretum, located in the suburbs outside of Chicago. The colorful foliage was reminiscent of fall back home in New England.

I hope you enjoy this issue. As always, if you have ideas on improving *Currents* or wish to contribute, please email me at sizzy@bwh.harvard.edu.

Happy Holidays!



Saef Izzy, MD
Editor-in-Chief

A Great Year for NCS

By Jose I. Suarez, MD

I feel honored and privileged to write my first column as 2018-2019 president of the board of directors of the best professional society there is: the Neurocritical Care Society (NCS). I again thank Gretchen Brophy for everything she did for NCS during her tenure, and I hope to maintain the standard of excellence she provided. In the next year, my vision is to continue our efforts for membership growth, support and enhance our research endeavors, advocate for NCS, cement our multidisciplinary culture, buttress our *Neurocritical Care* journal and solidify our global presence, and hold a strategic planning meeting. I will strive to foster an atmosphere of mutual respect and transparency among our multidisciplinary membership.

I started my tenure on the heels of a very successful 2018 Annual Meeting. We had the largest attendance thus far in the setting of a multicultural and multiprofessional scientific agenda. We heard from our Japanese-, Portuguese-, and Spanish-speaking members in their primary language about neurocritical care advances in their regions. In addition, we had two co-located meetings: The Fifth Neurocritical Care Research Conference and the International Cortical Spreading Depolarization Symposium. Overall, the scientific content of the 16th Annual Meeting matched its theme "Neurocritical Care Without Borders."

As I write this column, there are several important events happening that are news worthy. The Neurocritical Care Interest Group of the College of Intensive Care Medicine of Australia and New Zealand, our global partner Down Under, have organized a successful three-day neurocritical care extravaganza in Sydney on Nov. 14-16, 2018. The meeting is set to take place at the Royal North Shore Hospital in Sydney. The gathering is composed of a one-day "Brain: Neurocritical Care Symposium," followed by a two-day ENLS and neurosimulation course. In other international news, the 2018 Asian Chapter Meeting and the Korean Neurocritical Care Society Winter Symposium is taking place in Seoul, South Korea, on Dec. 14-15. NCS officers and representatives from Korea, Japan, India, Nepal, Australia, the Philippines and Singapore will be speaking at this important gathering. In addition, preparations are under way for the regional meeting of the Middle East Chapter in Dubai in the spring of 2019 and the South American Chapter in Buenos Aires in the fall of 2019. In the U.S., the American Board of Psychiatry and Neurology (ABPN) is continuing the development of the written cognitive examination for the board certification in neurocritical care for physician neurointensivists and has started the process of selecting members of the writing committee. Indeed, neurocritical care and NCS are clearly growing, expanding and exploding in all world regions except Antarctica.

As we prepare for the holiday season at the end of 2018, we must reflect and be thankful for all that has been accomplished by NCS and its wonderful and dedicated multiprofessional members. However, we also need to think about our challenges ahead. We need everyone's

help to continue our growth. Please volunteer during the NCS Get Involved Campaign. Volunteer committee appointments has already started. Our diversity is our strength. We need and we want you to participate. Please join NCS leaders and help lead the way.



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Neurocritical Care Researchers and the Road to Career Development Awards

By Lauren Koffman



This is the first installment in a *Currents* series that will feature neurocritical researchers who have been awarded career development awards, or K awards. Each person was asked to describe their research background, experience with the application process and a bit about their research project.



Jonathan Elmer, MD, is at the University of Pittsburgh Medical Center and says that writing the first draft of the grant was a learning experience but fun. Dusting the application off a year later to revise and respond to the pink sheet was painful. The novelty had worn off and the novel science already felt a bit like old news. He started dabbling with clinical research as a resident with a grant from the Emergency Medicine Foundation.

"I wasn't good at it and didn't like it. As a fellow, I completed a master's degree in clinical research and discovered that research was a lot more fun when done right. I transitioned from my fellowship program onto an institutional K12 from NHLBI, which was really instrumental in allowing me the time to develop both my science and me to a point where both were ready for an independent K."

His grant explores quantitative EEG after cardiac arrest. "We're working to develop new analytical tools capable of transforming this complex, longitudinal data into clinically actionable knowledge. In Aim 1, we're trying to identify non-invasive qEEG signatures of secondary brain injury, validated against invasive multimodality monitoring as our gold standard. In Aim 2, we're developing multidimensional trajectory models of qEEG over time and testing whether these models shorten the time to an accurate prognosis when added to conventional methods."



Christopher Anderson, MD, practices at Massachusetts General Hospital and recently pursued a K-R transition. "The K23 application process was straightforward but requires attention to detail, particularly as it pertains to the interaction between your research plan and your career development plan. A first-rate mentor is a key component, and the more developed their track record in academic mentorship, the better. K awards are really about the PI-mentor team, and I think one mistake people make is paying too much attention to their research strategy rather than the other critical components of the application."

He completed a formal research fellowship at Massachusetts General Hospital and the Broad Institute between residency and a critical care fellowship. "A dedicated post-doctoral fellowship was critical to my funding success. Following my critical care fellowship, I received an AAN CRTE, followed by my K23 and some institutional awards. During my K23, I also obtained a master's degree in translational investigation from Harvard

Medical School and performed a second post-doctoral research fellowship at Biogen Inc. I received my first R01 in the fourth year of my K23. I am also a PI of an AHA Strategically Focused Research Network in Atrial Fibrillation, studying the utility of polygenic risk scores in clinical practice for stratification of atrial fibrillation risk in cryptogenic stroke."

His research program is based on the population genetics of ischemic and hemorrhagic stroke. His AAN award studied genetic variants involved in the pathways serving mitochondrial bioenergetics and their associations with small vessel ischemic stroke and non-lobar intracerebral hemorrhage. "My K23 built on my track record in pathway-based genome wide analyses, focusing on genetic influences on lipid levels and their role in intracerebral hemorrhage risk and recurrence. In my R01, I am studying whole genome sequencing data to perform fine-mapping of genome wide association study signals, with gene-editing of leading signals to identify cellular phenotypes."



Raj Dhar, MD, from Washington University School of Medicine says he did not apply in his first few years as neurocritical care faculty until he was able to obtain permanent U.S. residency (after training in Canada) but was able to obtain AHA grant in the interim (as well as foundation award) to start a research career.

"Persistence pays off. I had prior K23 application on a different project and with a different mentor that was not funded and started work in a new area with a new mentor, which led to an institutional KL2 grant for two years." He obtained preliminary data prior to successful submission of K23 grant about two years ago but describes it as a long journey. Resubmission was required as the first application did not reach a fundable score, but he was able to respond to critiques including more relevant training and improving the focus on mechanisms (genetics) rather than clinical (prediction). He had no formal research training prior to or during fellowship, but the KL2 grant included significant research training including a focus on genomics (which was related to his research project), ultimately leading to Master of Science in clinical investigation degree at Washington University in St. Louis.

The overall goal of his project is to identify genetic markers that explain variability in rate of cerebral edema formation after ischemic stroke. The primary aim is to create and validate an imaging endophenotype that captures the dynamic change in edema formation over the first few days after stroke. "We are integrating automated image analysis (using machine learning on thousands of serial head CTs) to measure rate of edema formation with genomic data on this same large cohort of stroke patients to identify which genetic variants explain the heterogeneity in cerebral edema. This will both aid in the early prediction of malignant cerebral edema as well as identify potential targets for drug development to prevent or minimize edema formation."

Growing Mentorship Within Neurocritical Care

By Wren Sherrill, MSN, ACNP, and Alexis Steinberg, MD, on behalf of the NCS Trainee Committee

Mentorship is a time-honored practice of developing an individual's skills, talents and experience. It refers to a special relationship in which someone with more experience helps guide a less experienced individual. A mentor refers to someone who positively impacts a protégé by providing guidance, fostering insight and encouraging growth. Mentorships can be formal or informal and can be found in academia, the medical field and corporations. Often, people have many mentors and mentees in all different areas of life and throughout their lifespan.

The power of the mentor-mentee relationship can yield extraordinary benefits to both people and the organization as a whole. Mentees get advice, encouragement and direction, which leads to increased productivity, improved self-confidence, professional development and overall increased enjoyment of their work life. Mentors often experience improved leadership skills, enhanced job satisfaction through an exposure to new ways of practice or a fresh view on a topic, and the personal satisfaction of significantly contributing to another person's success. Organizations also reap critical indirect benefits from these relationships. They foster a supportive community, which improves recruitment, retention and commitment. With new members, they help provide a seamless and supportive induction. Given the increasing number of trainees within the field of neurocritical care, there is a growing need for mentorship within the society. Trainees who do not have dedicated neurocritical care units in their program or those with more unique pathways such as APPs and pharmacists require more formal mentorship programs to aid with career development.

The NCS Trainee Section (formerly the Resident and Fellow Section) wanted to bring such a mentorship program to the field of neurocritical care to create a venue for trainees and junior attendings to obtain more accessible mentorship. Thus, in 2017, the first NCS formal mentorship program was created. The first edition connected established neurointensivists from around the world with medical trainees in residencies and fellowships who were interested in the field of neurocritical care. In the second edition, the applicant pool was expanded to include pharmacy, nursing, nurse practitioners and physician assistants.

The Trainee Section carefully reviews applicants' resumes and CVs to match mentees to mentors with similar interests (clinical vs. research vs. education, etc). Once the matches are made, the pair is asked to develop a project together. The program is formally one year long, although the hope is for lifelong relationships to be established. Throughout the year, the pair works on their project together, communicating at least monthly. Projects range from case reports to quality improvement projects, to research projects, to developing a neurocritical care fellowship curriculum. (See Table 1 with examples of 2018 projects.) In addition to discussing the project, the mentor advises the mentee on career planning and professional development. To encourage this communication throughout project planning, the Trainee Committee reaches out to pairs with monthly discussion points that are relevant to early career development. (See Table 2 with examples of topics.)

This NCS mentorship program is connecting people across the globe and fostering lasting relationships. It is promoting growth and development of medical professionals within neurocritical care. Both mentors and mentees are creating meaningful relationships, gaining fresh perspectives and expanding their network. During a quarterly survey done during the program, one mentee remarked, "My mentors at [my institution] all have similar backgrounds and training, so it's nice to get a new perspective." Another mentee described the program as "a great opportunity to meet very talented people." Mentors' responses were also positive. When asked what they enjoyed about the program, one mentor stated, "I feel like I'm impacting another individual's career in a positive way."



The 2019 program is starting earlier this year in hopes to have more projects presented at the 17th Annual Neurocritical Care Society Meeting in 2019 in Vancouver. The call for applications went out late October and the deadline to apply was Dec. 12, 2018. Matches will be made in early January with project proposals due in February.

Besides creating a formal Mentorship Program through NCS, the Trainee Committee has tried to foster mentorship through other means. At the 16th Annual NCS Meeting, the Trainee Committee organized a Mentorship Mingle, which is a “speed dating” event between senior neurointensivists and junior attendings, residents or fellows. The event was well attended, with over 30 neurointensivists volunteering their time to speak to around 40 participants. The goal of the event is to spark mentorship relationships and encourage future communication between participants.

The first few years of a person’s career can set the trajectory for their entire career. Many trainees are in institutes that do not have dedicated neuro-intensive care units or have unique career trajectories, left without accessible guidance from senior healthcare providers within the neurocritical care field. The Trainee Committee created the mentorship program acknowledging the increasing need within the society and maximizing the benefits of being part of a supportive community. Using these connections to improve individual professional growth with the ultimate goal of advancing neurocritical care. The rewards for mentors, mentees as well as the organization as a whole are clear.

Table 1: 2018 Mentorship Program Projects

Development of a neurocritical care fellowship training core curriculum
A unit based EVD guideline
Development of an abstract and poster presentation of a quality improvement
Article on antiplatelet therapy for prevention of endovascular stent occlusion
Developing a neurology protection for PGY1 pharmacy practice residents
A case write-up
Research project on education to neuro ICU nurses regarding management of status epilepticus
Research project on endovascular treatment for patients with acute stroke with ESRD and HD
Research project on non-invasive cerebral oximetry for detection of LVO
Article on approaches to end of life decision making in Neuro ICUS
Proposal for research fellowship conducting a systematic review and meta-analysis for DCI in SAH
Grant proposal
A systematic review and meta-analysis
Study of cerebral edema in acute liver failure and acute on chronic liver failure

Table 2: Topics of the Mentorship Program

Discussion of career paths; How you got to where you are now
Finances: salary negotiations, grant funding, student loan repayment
Work-life balance
CV and resume review
Interview advice
Fellowship guidance
5, 10, 20 year plans; goal development
Difficult conversations
Ethics
Global outreach



Neurocritical Care at a Suburban Regional Medical Center: From the Perspective of a Recently Graduated Neurointensivist

By Kinjal Desai, MBBS, MD, MPH



“Virtually nothing is impossible in this world if you just put your mind to it and maintain a positive attitude,” says Lou Holtz.

NCS and the field of neurocritical care have come a long way in terms of how multidisciplinary care is delivered to complex life threatening neurologic emergencies. There are two main paths for the majority of trainees after completion of an NCC fellowship: 1) joining an academic medical center as a junior neurocritical faculty, or 2) taking a leadership role and being involved in developing or staffing a newly formed neurocritical care unit in a suburban, usually a non-academic or partly academic center. Although there are no scientific papers on the proportion of graduates who end up in academic medical centers versus non-academic centers, there are only so many positions to fill at any major academic medical center. This is in fact one of the toughest decisions in life and depends on lots of factors, such as interests in teaching, conducting cutting-edge research, being a part of famed institution, salary and having a good work-life balance, etc.

I have always wanted to be part of a growing organization. This is a challenge I gladly embrace every day since joining Clearlake Regional Medical Center (CLRMC) in Webster, Texas. CLRMC is a comprehensive stroke center and a level 2 trauma center. The current setup at CLRMC’s Neuroscience Division includes a 16-bed telemetry stroke unit and a six-bed Neurotrauma ICU (NTICU), which is staffed primarily by trauma surgery and patients being co-managed by Critical Care, Trauma, Neurosurgery and Neurology/Neurocritical care. My role apart from being the stroke director at CLRMC and its sister facility Mainland Medical Center includes providing neurocritical care consultative services in the ICU (neuro-ICU, CCU, MICU, SICU) and stroke unit.

I interviewed at 18 academic institutions for my neurocritical care fellowship prior to matching at Baylor College of Medicine. Although all the current training programs in neurocritical care are UCNS certified, there are still subtle differences among these. Some programs being critical care/procedure heavy, others being research heavy and the rest a mixed bag of both. Programs also vary based on whether these provide training for the fellows in neurotrauma. The majority of the UCNS accredited training programs train the fellows to successfully run and manage patients in a well-established neurocritical care unit. Building a neuro-ICU requires leadership skills, management skills and negotiation skills to be able to justify the primary role of a neurointensivists not only from a patient management but also a financial perspective to an institution.

Fellowship training in neuro-ICU at Baylor College of Medicine was vastly different from current neurohospitalist/neurocritical care consulting role at CLRMC. The primary difference being that of an academic neuro-ICU versus a non-academic neuro-ICU. Academic neuro-ICUs, as most of our readers are aware of, has been built from the ground up by practicing academic neurointensivists with set protocols and patient management strategies, in addition to ongoing clinical research trials and studies. The responsibility of building these at suburban/rural medical centers rest on our shoulders, thereby addressing the

fresh graduating crew from the neurocritical care fellowship. The neurointensivists of today are more than prepared to take care of these sick patients; however, creating a neuro-ICU requires a huge culture shift. This involves understanding the local politics of who has most stakes in the ICU and convincing the administration and departments of anesthesia/trauma/intensivists, the positive impact of a neuro-ICU being staffed by a neurointensivist.

Being a part of the local community and providing educational outreach, increasing awareness of risk factors for varied neurological diseases and providing neurocritical care services are some of my roles. The challenges, however, are many in terms of increasing awareness within the hospital as to what we do as neurointensivists and what a neurocritical care unit is. Beginning clinical research projects, developing registries and databases without any dedicated personnel to help is another mountain to climb and does make progress slow. The biggest hurdle for me currently is to justify my potential role to the administration of a primary neurointensivist staffing the NTICU and how this would help provide comprehensive and multidisciplinary care to patients by practicing evidence-based medicine. This is despite multiple global research studies explaining the better outcomes of patients suffering from ICH, SAH and ischemic stroke when managed by a primary neurointensivist in a neuro-ICU.

Despite the challenges I face every day, being able to take care of wide variety of patients in a consultative role does provides solace. Since more and more institutions across the country in suburban and rural areas strive to achieve comprehensive stroke status, the need to build neurocritical care units will continue to rise. As more senior members of the neurocritical care society come toward the end of their tenure, it is our responsibility as young neurointensivists to take these responsibilities and learn the steps of successfully building a neurocritical care unit. Formal training opportunities of leadership, program development skills and an in-depth understanding of various political factors that play a role in an organization/neuro-ICU are still a “work in progress” for the current fellowship training programs.



The Future of Neurocritical Care Research: Looking for a Blue Ocean

By Sara Hocker, MD; Shraddha Mainali, MD; and Andrew Naidech, MD



Sara Hocker, MD



Shraddha Mainali, MD



Andrew Naidech, MD

The fifth Neurocritical Care Research Conference, “The Future of Neurocritical Care Research: Looking for a Blue Ocean,” was held in Boca Raton, Florida, on Sept. 25, 2018. The primary aim of this interdisciplinary scientific symposium was to bring together scientists and healthcare professionals from diverse fields with a common interest in understanding and advancing research in neurocritical care and to set the agenda for the future direction of the Neurocritical Care Research Network (NCRN) and the Neurocritical Care Research Central (NCRC). The meeting had 125 registrants and 103 attendees from all parts of the world including the United States, Brazil, Israel, Canada, Colombia, Argentina, Chile, Japan, Italy, Germany, Austria and the UK. Attendees were 46 percent women, 39 percent minority and 28 percent junior members.

The conference opened with a review of the history and aims of the NCRN presented by Dr. Jose Suarez, followed by special lectures on the current status and innovative ideas in NCC research. The concept of using ideation techniques such as the blue ocean strategy to challenge the status quo was then introduced, and a lively discussion on the application of the concept to healthcare followed. Blue ocean is a concept from the business world developed by John Mullins and first published in 2005 by W. Chan Kim. It seeks to identify undiscovered markets, a “blue ocean.” Alternatively, a red ocean is an existing competitive workspace in which groups compete for the same customers. The Neurocritical Care Society is in fact, a blue ocean society, as its development created a new market space without existing competition. By comparison, the society journal, specialty certification, meetings and guidelines exist within red oceans because, while these are valuable and important products, there are many other societies and funding agencies pursuing similar concepts.

All participants were expected to read the book “Blue Ocean Strategy” and attend one of two webinars presented by Lawrence Aronhime, MBA, MS, an expert in ideation techniques, before the meeting. Three multiprofessional and multigenerational working groups (made up of five members each) were created and separately used the blue ocean strategy to answer questions posed within three broad topic areas, including: 1) NCRN driving the science, 2) NCRN driving research, and 3) NCRN driving the profession. These groups met regularly via teleconferences during the six months prior to the conference and drafted recommendations to be presented at the conference to a jury and

all attendees. The five-member jury (Mike Diringer, Robert Stevens, Gisele Silva Sampaio, Lori Shutter and Claudia Robertson) was tasked with advising the NCRN leadership on which recommendations presented by the working groups should be most heavily considered.

A wide array of ideas was debated, resulting in the following conclusions:

- We have not fully defined our diseases.
- It is too soon to focus on implementation strategies given the limited number of evidence-based strategies to implement.
- There is a tension between protocolized medicine and precision medicine.
- A translational link from the lab to the patient is needed.
- Optimal research strategies in NCC have not been defined (e.g., randomized controlled trial, clinical accelerator, creative trial designs such as comparative effectiveness).

After deliberation, the jury proposed the following seven recommendations for the NCRN:

1. Establish the right balance between game-changing scientific breakthroughs versus incremental discovery.
2. Enable/support the backwards translation of fundamental research.
3. Actively engage in new research methodologies such as big data, computational modeling and personalized/precision medicine.
4. Support development of grant proposals.
5. Partner with colleagues in other medical domains, basic science, engineering, government and the industry.
6. Develop infrastructure to train the new generation of NCC investigators (e.g., online, embedded research time, mentorship, etc).
7. Actively engage with partners in low-resource settings to conduct science and improve care.

Following the meeting, NCRN leadership met to discuss the recommendations generated in the meeting. The goal is to create a proposal for NCRN that will take NCS to the forefront of neurocritical care research and set a platform to address major problems faced by our patients.

Violence and Sexual Harassment in Healthcare a Growing Issue

By Peter J. Papadakos, MD, FCCM, FAARC



The last number of months has brought the issue of violence and sexual harassment into the news cycle. Employers and universities have rolled out programs to address discrimination and sexual harassment in the workplace. Health professionals and support staff are not immune from this issue. Media are full of reports of highly trained and educated healthcare workers assaulting each other, rising reports of sexual harassment and gender issues and assaults by patients and families on their health providers. The reasons for this increase in reporting are multifactorial and varied. Of course, the #MeToo movement has played a positive role in allowing individuals to report issues, but societal norms have also played a role to generate a zero tolerance to violence and discrimination.

The data for workplace violence in healthcare is sobering. The Occupational Safety and Health Administration (OSHA) has reported that the ratio for assaults on nurses was 25/10,000, whereas for other private sector industries, the ratio was 2/10,000 employees. The numbers may be even higher in that many healthcare workplace assaults are not reported and believed to be part of the job, and victims do not report them or may fear retribution. Everyone is at risk, from physicians, nurses, pharmacists, students, support staff and housekeepers. By far, nurses are at the highest risk, with 43.4 percent of reported assaults in healthcare with physicians at 13.8 percent.

Reports of sexual harassment in the workplace can easily decay the morale of staff and lead to poor patient care. We must have a zero tolerance to fellow healthcare providers making sexual advances, crude and demining jokes, provocative gestures and lack of respect to each other. We should expect an environment that is safe and respectful of the individual as they practice their profession. Units and hospitals should be at the forefront of providing this environment of mutual respect. Staff should feel comfortable reporting such issues early so that they can be acted on prior to any escalation.

How can the neurocritical care practitioner affect change and improve our workplace to decrease sexual harassment and workplace violence? First and foremost, we must address stress, tension, burnout and other factors that affect all levels of our team and patients. Many studies have confirmed that workplace stress, especially in healthcare, have led to poor performance, lasing out, burnout and even suicide. This horrific rise in healthcare provider suicide is especially depressing and needs to be addressed by each one of us. Each unit needs to have policies and programs to recognize employees at risk. ICUs are highly stress-filled environments where life and death are addressed each day. How many of us can state we have programs to discuss and provide support in a regular basis to not only our staffs but to patients and families?

We propose that ICUs provide such programs that deal with these issues. Weekly or daily debriefing meetings where stresses within the unit are discussed in an open forum—where staff feels comfortable and provides mutual support. Employees should also be exposed to education on how to deal with stress, harassment issues and workplace violence on a regular basis. Unit leadership should be proactive and act as a role model to rapidly address unprofessional behaviors such as sexual harassment, staff bullying, racism and ethnic slurs. Such behaviors have no place in healthcare or any other place in our lives. Employees should respect their leadership knowing that it is a safe haven to report issues in their professional and personal lives. Families and patients also need a robust system to defuse issues. Critical illness is a great stressor and may lead to lashing out at staff if not proactively addressed. Many units have weekly family council meetings where such issues are addressed. Staff should also work to identify families at risk and refer them to unit based social workers and support programs before issues arise. I can state without reservation that such programs have worked at my facility.

We must also be aware that our hospitals, universities and facilities also are mandated to have human resource support services to address workplace issues. New staff should be oriented to such programs and feel comfortable reporting issues in a confidential and supportive environment. There are also many agencies in healthcare that both track and enforce behavior in hospitals such as the The Joint Commission, state professional boards and the Council on Surgical and Perioperative Safety. They all have mechanisms of reporting and analyzing such issues. Of course, the final agency to report violence and sexual assault is law enforcement.

These are important issues that not only impact on our lives as healthcare providers but also impact on society as a whole. We must act as a role model to the rest of society on how to address these issues. Our society should evolve to prevent violence, injustice and sexual harassment in all aspects of our lives.

The Dead Donor Rule in the Era of Extremes in End-of-Life Care

By Deepa Malaiyandi, MD



From ECMO to assisted dying, the options for end-of-life care truly span the spectrum of therapeutic intensity. In the age of autonomy, global perspectives from all along this spectrum contribute to medical, ethical and legal opinions of death, dying and organ donation.

The dead donor rule (DDR), which has been an accepted ethical norm since the dawn of transplant medicine, has been interpreted both as a requirement for donors to be dead and/or a prohibition against killing through procurement. The essential goal of the DDR is to prevent the unethical removal of organs from vulnerable individuals.

By the mid-20th century, mechanical ventilation could maintain individuals with no brain or brain stem function. With these advances came the promise of heart transplantation. However, the idea of removing a person's heart provoked a fear that unconscious patients with a poor prognosis would be killed, in violation of the DDR to harvest this highly valued organ. Both because of these advances and in light of the fear of violating the DDR, a legal standard for determining death based on neurologic criteria was created.

Now, nearly three-quarters of a century after the creation of the DDR, we find ourselves in a familiar place. How do we interpret and apply the DDR in today's technologically advanced and socially progressive society? Do newer organ donation and procurement practices comply with the DDR? If a patient is determined to be dead by circulatory criteria and circulation is restarted with ECMO or cold perfusion fluid to improve organ quality, is that patient still dead? Do cold perfusion fluids slow neuronal death to the point that a "hands-off" time of two to five minutes is inadequate to comply with the DDR? Can assisted dying be coupled with organ donation without violating the intent of the DDR? The following three articles address these issues.

Dalle Ave AL and Bernat JL. Donation after brain circulation determination of death. BMC Medical Ethics. 2017. 18:15

This article proposes that the time has come to redefine the donation by circulatory death determination (DCDD) criteria as donation after brain circulation determination of death (DBCDD) to better satisfy the DDR. The authors feel that the advent of the term DBCDD is warranted for advanced technologies, such as ECMO, to be utilized in dead donors without prompting the question of whether or not these donors are still dead. Just as ventilators isolated the function of the lungs, so, too, has ECMO uncoupled the hearts' circulatory function from brain perfusion.

The proposed "brain circulation determination of death" states, "when systemic circulation ceases, the criterion of death is the permanent cessation of brain circulation. When organ donation is conducted, we call it donation after brain circulation determination of death or DBCDD."

By rephrasing existing terminology and adhering to the appropriate hands-off time, resuming systemic circulation by means of E-CPR, ECMO or cold perfusion fluids would not negate death declaration as long as cerebral circulation is excluded by means of aortic clamp or balloon.

This new definition of death would simplify the process of organ donation, though there is one important limitation. At this time, there is no test that is able to accurately confirm that cerebral circulation has been completely excluded and that no trace residual cerebral flow exists. Until an accurate test to do this has been developed, any technology that restarts systemic circulation would violate the DDR.

Omelianchuk A. How (not) to think of the "dead-donor" rule. Theor Med Bioeth. 2018. 39:1-25.

This article re-explores the original intent of the DDR and how it is applied today. The author states that the "death requirement" is merely the operational result of a precautionary approach to maintaining compliance with the "do not kill rule," which he describes as the moral core of the DDR. He argues that the "do not kill rule" is less restrictive as it allows for vital organ procurement in cases where surgery is causally unrelated to death. He makes the case that focusing on when it is acceptable to remove vital organs would provide more useful answers than continuing to debate the criteria defining the precise moment when death has occurred. While this article posits that it is never acceptable to kill, changing societal views regarding assisted dying may help move this discussion forward as exemplified by the next article.

van Dijk G, van Bruchem-Visser R, de Beaufort I. Organ donation after euthanasia, morally acceptable under strict procedural safeguards. Clinical Transplantation. 2018. 32:e13294.

This case report provides an example of how organ donation can be combined with voluntary euthanasia (ODE) in a just and ethical way. In 2015, a middle-aged gentleman in the Netherlands underwent assisted dying five years after a stroke left him dependent for all activities of daily living. Unlike the U.S. Death with Dignity Act, the Netherlands, Luxemburg, Belgium and Canada do not require a prognosis of less than six months in order to qualify for assisted suicide. The patient felt that his life consisted of insurmountable suffering and was devoid of both quality and dignity. He requested assistance with dying and the opportunity to donate his organs. It was the first such request encountered by his medical team. The article describes the process they followed to ensure that the desire to donate was distinct from the intent to die. Patients with progression of severely debilitating neurologic disorders, such as end stage MS or ALS, are often cited as potential candidates for ODE, but the rarity of these disease processes would contribute little to the growing need. This case of an individual with ischemic stroke, a common disease worldwide, suggests that ODE represents a potential for a sizable source of donor organs where voluntary euthanasia is practiced. More importantly, it demonstrates how ODE can satisfy the DDR and combine respect for persons, autonomy, compassionate end-of-life care and altruism to save lives.

Neurocritical Care Society

Pharmacy Section Year in Review

By Jason Makii, PharmD, MBA, FCCM, FNCS, BCPS, BCCCP, Chair, Pharmacy Section Leadership Committee



The pharmacy section continues to expand, and we have celebrated numerous successes this past year. Continued recruitment efforts have resulted in over 175 pharmacist members within the section, an increase from last year. Over 65 pharmacists attended the annual meeting in Florida last September with various members presenting their research, moderating sessions and speaking on various topics throughout the annual meeting. I would like to acknowledge and thank the outstanding committee members for their service and dedication this past year. A special thanks to Eljim Tesoro for his outstanding leadership of the Pharmacy Section for the past three years; the successes and growth of this section described in this review are a direct result of his leadership. I would also like to recognize Dr. Gretchen Brophy, who completed her term as the first pharmacist president of NCS this year. Her support and dedication to NCS and the Pharmacy Section have resulted in the continued growth and engagement of neurocritical care pharmacists within the society.

Pharmacotherapy of Neurocritical Care Series (PONS)

The third volume of PONS topics were released this past year. Topics covered in volume 3 include Substance Withdrawal in Neurocritical Care, Challenges in ICU Care—The Parkinson Patients, Reversible Cerebral Vasoconstrictive Syndrome (RCVS), Indications and Considerations for the Use of Antiplatelet Agents in Neurocritical Care, Medication Safety in Neurocritical Care, and Non-opioid Options for Treating Subarachnoid Hemorrhage Induced Headache. This on-demand webinar series currently offers 22 core pharmacotherapy topics with four new releases planned for 2019. The PONS series is an innovative tool to promote dissemination of updated information to clinicians as well as trainees and aligns with the educational mission of the society. It is one of the most visited pages on the NCS website. Thank you to this year's PONS chairs, Mehrnaz Pajoumand and Jeffrey Mucksavage. This is a particularly valuable resource for trainees and nurses.

Learn more here: <https://www.neurocriticalcare.org/education/digital-education/pons>

Invited Clinical Pharmacist (ICP) Program

The ICP program was designed to promote and increase neurocritical care pharmacy services to medical centers and universities across the country. Applicants can request a senior pharmacy section member to visit their institution to meet with neurocritical care and hospital stake holders, attend multidisciplinary rounds and provide a guest lecture. This past year, Dr. Gretchen Brophy visited the UC Davis Health System and interacted with the neurocritical care team on rounds and through a grand rounds presentation. Kendra Schomer, PharmD, and Lara Zimmerman, MD, were the site leads who coordinated the visit and presented their experience at the Pharmacy Specialty Focus Corner at the annual meeting.

Applications for the 2019 ICP are available on the NCS website. This is a great resource for institutions that would like to initiate &/or expand pharmacy services in their neurocritical care areas.

Learn more here: <https://www.neurocriticalcare.org/research/nrcr>

Publications

2018 marked another productive year for members of the pharmacy section for articles in *Neurocritical Care* journal. A few publication highlights include:

- Gabriel Fontaine reported on three-factor versus four-factor prothrombin complex concentrate for the emergent management of warfarin-associated intracranial hemorrhage. (*Neurocrit Care* (2018) 28: 43. <https://doi.org/10.1007/s12028-017-0374-y>)
- Theresa Human was the lead author on a randomized trial of brief versus extended seizure prophylaxis after aneurysmal subarachnoid hemorrhage (*Neurocrit Care* (2018) 28: 169. <https://doi.org/10.1007/s12028-017-0440-5>)
- Dr. Human also contributed with Amanda Lamer-Rosen to the standards for neurologic critical care units: a statement for healthcare professionals from the neurocritical care society (*Neurocrit Care* (2018) 29: 145. <https://doi.org/10.1007/s12028-018-0601-1>).
- Denise Rhoney reported on the influence of single-dose antibiotic prophylaxis for early-onset pneumonia in high-risk intubated patients (*Neurocrit Care* (2018) 28: 362. <https://doi.org/10.1007/s12028-017-0490-8>)

Neurocritical Care ON CALL

Neurocritical Care ON CALL was released earlier this year and included the following pharmacist contributors: Stephanie Bennett, Yana Bukovskaya, Jennifer Bushwitz, Meghan Caylor, Sarah Clark, Kristen Ditch, Michael Erdman, Salia Farrokh, Shannon Giddens, Kristy Greene, Leslie Hamilton, Theresa Human, Mathew Korobey, Lisa Kurczewski, Kimberly Levasseur-Franklin, Jason Makii, Casey May, Christopher Morrison, Kent Owusu, Mehrnaz Pajoumand, Dennis Parker, Deepa Patel, Brianne Ritchie, Amanda Lamer-Rosen, Eljim Tesoro, Andrea Tully, and Ryan Waybright.

Learn more here: <https://oncall.neurocriticalcare.org/home>

NCS Annual Meeting

Over 65 pharmacist members attended the Annual Meeting in Boca Raton, Florida this past September. The pharmacy section had great engagement throughout the annual meeting with speakers, moderators and workshop/course directors. Thank you to Leslie Hamilton and Christopher Morrison for promoting pharmacist involvement through the Annual Meeting Planning Committee.

The Pharmacotherapy workshop was directed by Jason Makii and showcased presentations on:

- Anti-Xa monitoring in neurocritical care patients (Keri Kim)
- Safe administration practices for high alert medications (Emily Durr)
- Cannabidiol use in the neurocritically ill (Kent Owusu)
- The impact of the new AHA blood pressure guidelines (Caroline Der-Nigoghossian)
- A debate on short vs. prolonged antibiotic administration in neurocritical care patients (Meghan Caylor and Salia Farrokh)
- Strategies to maintain neurocritical care pharmacotherapy in an era of drug shortages (Kimberly Levasseur-Franklin)

Other pharmacy section involvement included the following:

- Shaun Keegan presented during the survivorship after critical illness: challenges and strategies for post-intensive care syndrome session
- Sherif Mahmoud presented in the Individualizing therapy and prognostication for patients in the neurocritical care unit session
- Christopher Morrison and Salia Farrokh also presented on the latest advances in the management of neurocritical care complications
- Karen Berger, Jeffrey Mucksavage, Emily Durr and Kimberly Levasseur-Franklin represented the pharmacy section during the Debates Session.
- Christopher Morrison also presented during the ENLS train the trainer course
- John Lewin and Gretchen Brophy shared their leadership experience during the Future Clinical Leaders Forum

Please visit the on-demand section of the NCS website if you are interested in any of the presentations from the 2018 Annual Meeting: <https://www.pathlms.com/ncs-ondemand>

Finally, the Pharmilia runners raised \$445 placing them third in the Run for Research rankings and Jason Makii represented the pharmacy section on the winning scramble team during the golf for research outing.

Presidential Citations and Awards

The NCS presidential citation is an award that recognizes members who have shown exceptional support and dedication to NCS and have contributed to the neurocritical care community. Pharmacy section recipients at the annual meeting included Karen Berger, Aaron Cook, Salia Farrokh, Theresa Human, Kimberly Levasseur-Franklin, John Lewin, Jason Makii, Christopher Morrison, Jeffrey Mucksavage, Mehrnaz Pajoumand, Keri Kim and Eljim Tesoro.

Section recipients of the 2018 Annual Meeting Travel Grant included Kara Birrer, Olabisi Falana, Gabriel Fontaine, Allison Rider, Keaton Smetana and Jessica Traeger.

Three section members were inducted as Fellows of the Neurocritical Care Society (FNCS) at the annual meeting. Congratulations to Christopher Morrison, Jason Makii and Eljim Tesoro.

Pharmacist engagement in NCS continues to remain prominent and we encourage all members to get involved within the society. Feel free to contact me to share ideas and to get involved within the section (jason.makii@uhhospitals.org). On behalf of the pharmacy section leadership, I want to thank the section members for another successful year and we look forward to working with everyone in 2019. Have a safe and happy holiday season!

Caring for the Post Procedure Mechanical Thrombectomy Patient

By Catrice Nakamura RN, MSN, CCRN-K, SCRN, and Diana Serondo, RN, NVRN-BC

Mechanical thrombectomy in the setting of a large vessel occlusion has become a standard of care in the management of acute ischemic stroke. Despite the ample literature available to support care before and during these procedures, few publications focus on the details surrounding care of these patients in the immediate post-operative period. As mechanical thrombectomies are becoming more common, the argument could be easily made for increased nursing education on the care of this unique population.

Pre-Procedure

Hospitals across the country have created code stroke protocols that allow for the rapid diagnosis and management of acute ischemic stroke patients presenting with large vessel occlusions. An integral part of these protocols includes performing and documenting a thorough neurological and peripheral vascular assessment on admission. This piece is crucial in helping providers identify changes from the baseline exam and helps decrease confusion and prevent complications as the patient transfers from one location to the next. Though defined elements of the exam and time frames may vary according to hospital protocols, most comprehensive neurological assessments include NIHSS score, Glasgow Coma Score and motor strengths. When performing bilateral peripheral vascular assessments in the lower limbs, make sure to assess and document the five Ps; pain, pallor, pulses, paresthesia and paralysis.

For patients who qualify for concurrent treatment with alteplase, NIHSS and serial neuro checks are recommended at minimum. These assessments shall include serial vital signs and neuro checks at the following intervals: Q 15 minutes during infusion, Q 15 minutes x 1 hour after completion, and then Q 30 minutes x 6 hours then Q 1 hour x 16 hours as recommended by Genentech USA Inc.

The last critical baseline pre-procedure assessment parameter is blood pressure. Blood pressure is usually elevated in the setting of an acute ischemic stroke as the body tries to maintain adequate cerebral perfusion. Aggressive treatment of hypertension in these instances is not recommended and may even be considered harmful. Establishing clear blood pressure goals and maintaining these goals with appropriate medications is essential.

Post-Procedural Care and Assessment

Patients are often admitted to the neuro-ICU post-procedure. Post-op care includes diligent monitoring of neurological and neurovascular status and continuous monitoring of vital signs. Blood pressure goals post-procedure should be ordered and communicated to the nursing staff and managed with appropriate medication. Close surveillance of neurological status is crucial because up to 37 percent of stroke patients may decline within the first 24 hours. While serial neurological assessments are key, some literature suggests using frequent NIHSS assessments as the standardized serial neurological assessment. While the NIHSS exam may take longer to perform, it has demonstrated the ability to capture neurological changes that have can be missed by abbreviated neurological assessments. For more information on

NIHSS assessments, see "Slim Stroke Scales for Assessing Patients with Acute Stroke: Ease of Use of Loss of Valuable Assessment Data?" (*American Journal of Critical Care* 2012; 21:442-447). Any changes in neurological assessment should be reported to the interventional team immediately.

Additional immediate post-procedure assessments include assessment of the groin site and distal extremities. The groin site should be assessed at regular intervals as per hospital protocol and should be soft to touch and without remarkable tenderness. Serial neurovascular assessments include assessment of the distal extremities, again noting the five Ps with attention to pulse quality, limb temperature and any signs of neurovascular compromise.

After the first few hours, continued care of the patient post-thrombectomy is largely similar to care of a patient who did not receive endovascular treatment. However, care should focus on continued serial neurological assessments and monitoring of physiological parameters and neurovascular assessments so that potential complications can be caught early.

Potential Complications

Post-procedural complications can be associated with the access site. Post-procedure, the nurse should be aware of and assess for these potential complications. Access site complications include retroperitoneal hemorrhage, pseudoaneurysm, arterial occlusion neuropathy and infection. For additional readings on potential site complications after mechanical thrombectomy, see "Groin complications in endovascular mechanical thrombectomy for acute ischemic stroke: a 10-year single center experience" (*Journal of Neurointerventional Surgery* 2016; 8: 568-570).

Another potential complication is hyperthermia. Identifying the source of fever should be a priority of care. Patients should be treated aggressively with antipyretics and cooling measures and perhaps a normothermia protocol. While hypothermia has demonstrated benefit in cardiac arrest patients, it has not been shown to be beneficial in ischemic stroke patients.

Hyperglycemia in ischemic stroke patients is a predictor of increased 30-day mortality and parenchymal hemorrhage within the first seven days. The implementation and maintenance of a normoglycemia protocol and careful management is key to prevention of these complications especially during the first 24 hours after onset of stroke. Refer to "Correlation of hyperglycemia with mortality after acute ischemic stroke" (*Therapeutic Advances in Neurologic Disorders* 2017;11 doi: 1756285617731686)

Conclusion

Mechanical thrombectomy is a relatively new treatment offered to acute ischemic stroke patients. While little exists in the literature that offers guidance on post procedural assessments, basic assessments include much of what is performed for the non-interventional ischemic stroke patient. The goal is to establish assessment consistency across levels of care, a clear understanding of monitoring parameters and potential complications.

Cleveland Clinic's Neurocritical Care Is in Abu Dhabi

By Jamil R. Dibu, MD, Section Head, Neurologic Critical Care Unit, Cleveland Clinic Abu Dhabi, United Arab Emirates



Why is Cleveland Clinic in Abu Dhabi?

As a direct expansion of the Cleveland Clinic model of care, Cleveland Clinic Abu Dhabi builds on almost 100 years of excellence at Cleveland Clinic, aligning its services to meet the specific needs of the United Arab Emirates population.

The hospital is the result of an agreement signed in 2006 between Mubadala Investment Company and U.S.-based Cleveland Clinic, in support of the Abu Dhabi government's Economic Vision 2030 to develop a robust healthcare sector in the emirate. Its mission is to offer patients in the UAE and the wider region access to world-class care, close to home.

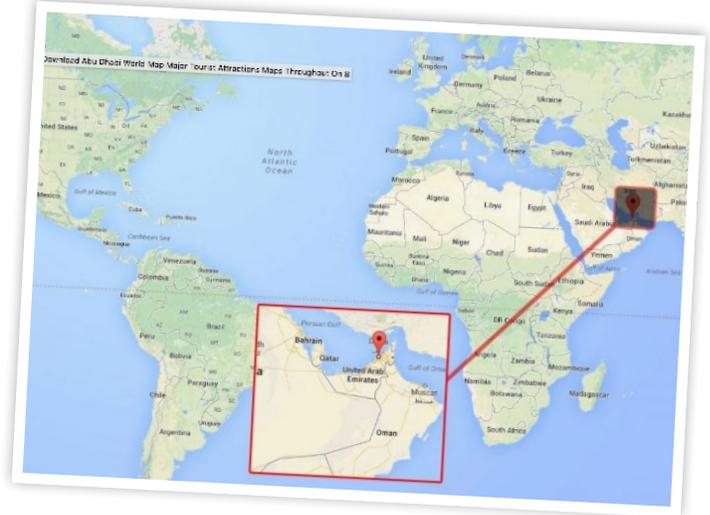
What are the standards and the staffing model of CCAD's Neurologic Critical Care Unit?

CCAD's Neurologic Critical Care Unit (NCCU) is a state-of-the-art, 24-bed intensive care unit, staffed 24 hours a day by intensivists and nurse practitioners with various training backgrounds (neurology, anesthesia and internal medicine-medical ICU) of which three UCNS neurocritical care board certified neurointensivists. We follow a closed ICU model of care whereby we ensure discussing the plan and rounding jointly on our patients daily with consulting teams.

Meeting the level 1 NCCU standards, our neuro-ICU multidisciplinary team includes more than 80 nursing staff coming from over 15 different backgrounds and nationalities as well a dedicated neuro-ICU pharmacist, respiratory therapist, social worker, case manager, dietitian, physical therapist/occupational and speech therapists rounding together jointly and daily on our patients.

What resources and services does CCAD's NCCU have?

We are fully resourced with an in-unit portable CT scanner, 24 hours a day access to CTs (including CT perfusion with RAPID software) and MRIs covered by three neuroradiologists, transcranial doppler (in-unit) and daily TCCDi capability, 24/7 portable video EEG monitoring availability covered by four epileptologists.



Our neurosurgeons cover all-spectrum services from open cerebrovascular surgeries, to pituitary, epilepsy and tumor surgeries, readily available for any emergency procedures such as ICP insertion and decompressive craniectomies. Five neuro-interventionalists provide 24/7 coverage of all emergency interventional cases such as mechanical thrombectomy and securing ruptured aneurysms within 24 hours of admission.

What is the average patient census, demographics and predominant diseases population in the NCCU?

Mentioning Abu Dhabi's population demographics is important to understand the unique patients population we admit to our unit. Our stroke program's primary target population consists of the Emirate of Abu Dhabi. In mid-2016, this was estimated close to 2.8 million, 500,000 United Arab Emirates (UAE) nationals (of whom 2/3 are under age of 30) and 2,300,000 non-nationals. In 2012, it was reported that 1,500 strokes were admitted across the Emirate of Abu Dhabi, and it has been reported that 8,000 strokes happen per year across the whole of the UAE.



CCAD's stroke program was designated as the Center of Excellence for Stroke Emergencies in Abu Dhabi Island and the western regions in October 2015 by the ministry of health, given our unique setup of providing standard of care 24/7 for ischemic and hemorrhagic strokes. Also, we have just successfully passed the Joint Commission International Accreditation Survey for stroke center designation after meeting all key metrics of a comprehensive stroke center, to be the second accredited center in the UAE, and only the third in the Middle East region.

Since CCAD went operational in May 2015, our average yearly admissions for stroke patients have been rising, receiving overall 392 stroke patients in 2017 with the following breakdown: 257 ischemic strokes (of which 33 received t-PA and 46 underwent mechanical thrombectomy), 57 subarachnoid hemorrhages and 78 intracerebral hemorrhages. Thus, our patient's population is predominantly cerebrovascular and young (i.e., average age for hemorrhagic strokes is 48 years); however, we also see the entire spectrum of neuro-ICU diseases such as subdural hematomas, status and super refractory status epilepticus, neuromuscular emergencies, post-operative tumor resections and meningoencephalitis.

Cleveland Clinic Abu Dhabi is composed of 14 institutes, including the following centers of excellence: Heart & Vascular, Neurological, Digestive Diseases, Eye, Critical Care and Respiratory. The hospital is designated and licensed by the Abu Dhabi Department of Health as a research and teaching facility and is working to become a pioneering academic medical center for the region. Cleveland Clinic Abu Dhabi employs 330 physicians, and around 25 percent have trained or worked at Cleveland Clinic in the U.S.



Highlights from the 7th International Hypothermia and Temperature Management Symposium in Sydney

By Andrew Cheng, MD



How do you measure neurological outcome after acute brain injury? What is the optimal dose and duration of targeted temperature management after cardiac arrest? How does this differ in traumatic brain injury? And how can this be best measured and monitored in the neuro-ICU? These were among some of the questions posed, discussed and debated at the recent seventh International Hypothermia and Temperature Management Symposium, held in Sydney, Australia, from Aug. 28-30, 2018.



The Sofitel Darling Harbour, next to the new Sydney International Convention Centre and Sydney Aquarium, provided the setting for the seventh International Hypothermia and Temperature Management Symposium.

A biennial conference organized by scientific experts in the field of targeted temperature management (TTM) in emergency and critical care medicine, the symposium has its foundations in Japan when the inaugural meeting was held in Tokyo in 2004, organized by professor Nariyuki Hayashi. Subsequent meetings have been held in Miami (chair Dalton Dietrich), Lund, Sweden (co-chairs Hans Friberg and Tadesz Wieloch), Tokyo (chair Ken Nagao), Edinburgh, Scotland (chair Peter Andrews) and Philadelphia (co-chairs Fred Rincon and David Gaeski).

Chaired by Manoj Saxena and Naomi Hammond, with major academic sponsorship by The George Institute for Global Health and the University of New South Wales, this symposium focused on recent advances in the field of temperature management related to basic science, clinical research and innovative technology with the objective of translating contemporary scientific knowledge into a practical message that can be applied to everyday clinical practice. Highlights included the plenary sessions given by professors Alistair Gunn (Auckland, New Zealand), Peter Andrews and Dalton Dietrich.

Following an outstanding exposition of the preclinical foundations of therapeutic hypothermia, professor Gunn proceeded in his next

lecture to demonstrate how hypothermia has shown significant impact on improving outcomes after neonatal birth asphyxia. A paediatrician scientist who has conducted groundbreaking basic research on the mechanisms and treatment of asphyxial brain injury, professor Gunn helped to develop a range of novel, clinically relevant fetal sheep paradigms with research that helped to establish the technique of “therapeutic cooling” to reduce brain injury due to low oxygen levels at birth.

Professor Andrews presented his plenary on the future of hypothermia for traumatic intracranial hypertension after Eurotherm. This was a particularly important discussion in light of all the recent clinical trials of therapeutic hypothermia in traumatic brain injury (TBI) that have failed to demonstrate a positive impact of temperature management—despite decades of basic science research that have demonstrated the effects of even small variations in temperature on neuronal vulnerability and the negative impact of fever on neurological outcome after acute brain injury.

Professor Dietrich, who is editor-in-chief of the *Therapeutic Hypothermia and Temperature Management* journal and one of the founding chairs of the IHTMS, shared in his plenary some of the research work he and his team have conducted on the effects of brain temperature on inflammation and the cerebral vasculature in mild TBI (or concussion) work, which had recently been acknowledged in the form of a \$1.6M grant by the National Institute of Health (NIH) and National Institute of Neurological Disorders and Stroke (NINDS).

New themes introduced at this symposium included the emerging role of extracorporeal membrane oxygenation (ECMO) and advanced multimodality monitoring, not only to monitor neurological recovery of the patient but to refine the delivery of TTM and improve our understanding of the neurobiological processes that take place during temperature management.

Sessions on ECMO included presentation of the Australian ECMO-CPR study by Andrew Udy (Melbourne, Australia), while Tetsuya



Panel discussion, chaired by Manoj Saxena and patient advocate Nyrie Simpson, on measuring outcomes—what really matters?

Sakamoto and Noritoshi Ito (Japan) presented the findings of the SAVE-J study, a prospective registry of patients who underwent extracorporeal E-CPR vs standard care. Marc Conterato (Minneapolis) presented the case for induced hypothermia/ECMO in pre-hospital care for patients with refractory cardiac arrest with the experience of the Minnesota Resuscitation Consortium initiative.

Raimund Helbok (Innsbruck, Austria), who leads research in a major tertiary university hospital where multimodality monitoring is a standard of care, demonstrated the clinical utility of online monitoring of brain metabolism using microdialysis during TTM. The session received further contributions by Tobias Cronberg (Sweden) on the Lund experience of using continuous EEG for monitoring after cardiac arrest, Jonathan Rhodes (Edinburgh, Scotland) on the findings of brain tissue oxygen monitoring in TBI from the Eurotherm study, Anders Aneman (Sydney, Australia) on cerebrovascular autoregulation studies in post-cardiac arrest patients who received TTM, Kei Nishiyama (Japan) on TTM stratified by regional SO₂ as measured by near infrared spectroscopy (NIRS), in addition to discussions on post-resuscitation brain monitoring by Markus Skrifvars (Helsinki, Finland) and Xiaofeng Jia (Baltimore).

Thematic sessions on the practical implementation of TTM was opened by a lecture entitled "Pharmacology and Induced Cooling: a Two-Way Street" by NCS immediate past president Gretchen Brophy (Virginia). Novel modalities of cooling featured in a session presented by Jon Rittenberger (Pittsburgh), Fred Rincon (Philadelphia), Kelly Harbour (Sydney) and Takahiro Miki (Japan).

Chair Manoj Saxena discussed fever prevention or induced normothermia for TBI as a concept for future study while some key current studies were then presented. Hans Friberg (Lund, Sweden) presented the international multicentre TTM-2 study after cardiac arrest, David Greer (Boston) presented the INTREPID study of fever prevention for acute vascular brain injury while Hitoshi Kobata (Osaka, Japan) discussed how hypothermia induced prior to emergent evacuation of acute subdural haemorrhage might influence outcome, as studied in the HOPES trial. This was followed by presentations of recent published clinical trials, including the HEAT study of permissive hyperthermia in severe sepsis by Paul Young (Wellington, New Zealand), the paediatric cardiac arrest trials by John Beca (Auckland, New Zealand), the J-Pulse HYPO registry by Hiroshi Nonogi (Shizuoka, Japan), the Hypothermia for Septic Shock study by Morten Bestle (Copenhagen), TTM studies for septic shock and meningitis by Frederique Schortgen (Paris) and the Time-

differentiated Therapeutic Hypothermia (TTH48) trial by Hans Kirkegaard (Aarhus, Denmark).

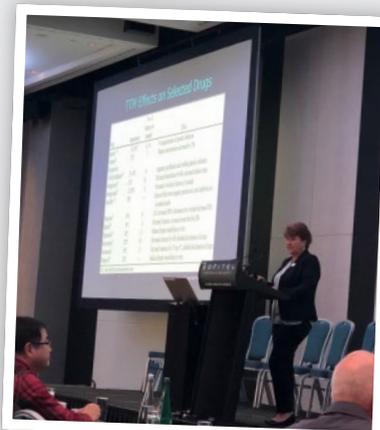
One of the highlights of the symposium was a session devoted to improving how we assess long-term outcomes after brain injury. Following plenaries by Gisela Lilja (Lund, Sweden) and Carol Hodgson (Melbourne, Australia) on measuring outcomes in terms of neurocognitive and physical function, respectively, an interactive discussion followed in which a panel of multidisciplinary experts engaged with patients who had suffered traumatic brain injury and stroke. This well-received and widely acclaimed session offered the opportunity for both faculty and delegates to interact and learn about what really matters to our patients as an outcome after a life-changing brain injury.

Finally, one of the features of the IHTMS is the award of the Hayashi prize for the best oral abstract presentation of experimental or clinical research. This year, it was awarded to Akihiko Inoue (Japan) for his presentation, "Increased heart rate response during the rewarming phase of therapeutic hypothermia is associated with favorable neurological outcomes in out-of-hospital cardiac arrest patients." Ome detō, mata au ma de (congratulations, and 'til we meet again)!

Andrew Cheng, MD, is senior staff intensivist at St. George Hospital, a major teaching hospital in Sydney for the University of New South Wales, with clinical focus in neurocritical care. His research interests include targeted temperature management in acute brain injury. Cheng was convener for the seventh International Hypothermia and Temperature Management Symposium.



Dining with faculty and friends on Sydney Harbour at the IHTMS.



Gretchen Brophy delivering her lecture on "The Pharmacology of Induced Hypothermia: a Two-Way Street."



Award of the Hayashi Prize to Akihiko Inoue of Japan by Symposium Chair, Manoj Saxena.



The Australian Zoo, located in Darling Harbour, was the setting of the welcome ceremony that greeted delegates to the Symposium.

Neurocritical Care in Tan Tock Seng Hospital, Singapore

By Jensen Ng, MBBS, MMed

Tan Tock Seng Hospital (TTSH) was founded in 1844 and is the second largest hospital in Singapore with a capacity exceeding 1,500 beds. It is strategically located in Central Singapore, at the intersection of two major highways.

The Neuroscience ICU (NICU) of TTSH has been in operation since the official opening of the current hospital premises in 2000. Since then, it has expanded to its current capacity of 14 Level 3 beds and four Level 2 Beds. The NICU functions as a single unit under the leadership of the NICU Director Dr. Wong Yu Lin from anaesthesiology, intensive care and pain medicine, with co-directors from neurosurgery and neurology, Dr. Ng Yew Poh and Dr. Oh Chia-Theng Daniel.

NICU patients admitted under the neurosurgery service are jointly managed by specialists from the departments of neurosurgery and anaesthesiology, while the specialists from neurology manage the patients admitted under the neurology service. All NICU patients receive multidisciplinary care from allied health professionals such as respiratory therapists, pharmacists, physiotherapists, speech therapists, occupational therapists and dieticians. A neurosurgery grand round takes place weekly. Twice a week, a multidisciplinary round comprising infectious disease specialists, microbiologists, pharmacists and intensivists discuss cases involving complex infections.

In 2017, the NICU admitted 1,824 patients, which represented a 2.8 percent increase from the year before. Of these, 789 were Level 3 patients. Seventy percent of the Level 3 patients were neurosurgical cases. As a tertiary center, it also frequently receives transfers from peripheral and foreign hospitals. In 2017, it accepted 35 such transfers.

The NICU of TTSH supports the clinical needs of the National Neuroscience Institute (NNI), caring for many of the patients before and after their major surgical and interventional radiology procedures. The NNI is the largest tertiary neuroscience center in Singapore and is renowned both locally and in the region for its clinical and research excellence.

The highly specialized clinical staff of the NNI include 15 neurosurgeons and five interventional neuroradiologists.

In 2017, 58 mechanical thrombectomies were performed. Fifty coilings for intracerebral aneurysms were carried out, of which 70 percent were done on an emergent basis. A total of 1,195 neurosurgeries were performed in 2017, of which 654 were emergency surgeries. The top three surgeries were extraventricular drain insertion (151), decompressive craniectomy (128) and burrhole drainage (76). Fifty-nine aneurysm clippings and 59 excisions of intracerebral tumors were carried out. These figures attest to the volume and complexity of cases seen at NNI and TTSH NICU.

Quality Improvement (QI) Initiatives in NICU

The NICU in TTSH has been active in pursuing quality improvement projects for the betterment of our patients. QI initiatives such as improving enteral nutrition delivery in intubated NICU patients, enhancing palliative care for NICU patients, urgent reversal of warfarin coagulopathy in NICU patients with intracranial hemorrhages (conjoint project with emergency medicine department), reducing oro-facial pressure ulcers due to endotracheal tube in intubated NICU patients and reducing catheter-associated urinary Tract infections are some examples of the continuous endeavors to improve patient-centric outcomes, and are part of the larger hospitalwide effort on organizational excellence. Many of these projects were initiated by our nursing colleagues.

International Outreach

The clinical staff of the NICU is actively engaged in the region to promote the development of neurocritical care, conducting regular training courses in neighboring countries (ASEAN countries such as Indonesia and Cambodia). In addition, the NICU regularly hosts observers from these countries on short attachments in order to share our experiences in our high-



acuity, high-volume center. Besides core medical and nursing knowledge and skills of neurocritical care, important aspects in soft skills such as communication with family and relatives, breaking bad news, resident teaching, ICU management and leadership are shared with the observers. These initiatives are sponsored by Singapore-based nonprofit philanthropic organizations (such as Temasek Foundation International and Lee Foundation) that fund and support programs that aim to build capabilities in communities in Asia. Designed and implemented with TTSH as the program partner, these collaborations advance neurocritical care in the region.

Education

The NICU is heavily involved in training and education, receiving anaesthesiology and critical care specialist trainees from hospitals across the country. These trainees undergo structured teaching programs and also benefit greatly from the high volume and varied case mix.

This year, trainers from the NICU conducted the inaugural Emergency Neurological Life Support (ENLS) course in the country. The response was overwhelming, reflecting an unmet need for a comprehensive training workshop addressing basic neurocritical care. It involved 31 participants from various backgrounds and levels of training. Several international faculty including Dr. Gene Sung, past president of the Neurocritical Care Society, were on hand to share their vast experience with the participants.

To complement the ENLS program, the course incorporated other elements central to neurocritical care, namely neuromonitoring, EVD management, neurological determination of death and neuroradiology. It also included a NeuroSimulation Workshop, where the participants had the opportunity to put what they learnt into practice in a realistic but safe environment.

Participants and trainers at the first ENLS in Singapore during the NeuroSimulation workshop at the Simulation Lab of TTSH.



International colleagues from the ASEAN region on short observerships in the NICU

First Regional Neurocritical Care Meeting in Asia

By Sang-Bae Ko, MD, PhD

The Korean Neurocritical Care Society (KNCS) held the first regional Asian Chapter Neurocritical Care Society (NCS) Meeting in conjunction with KNCS Winter Symposium on Dec. 14-15, 2018 in Seoul, South Korea.

The original idea for boosting quality of neurocritical care in Asia had been discussed with Dr. Gene Sung, and KNCS are lucky to have a chance to host the first Asian Chapter meeting in Seoul with a full support from Asian neighbors including Japan, Philippines, Nepal, India, Singapore, Indonesia and Australia. All Asian partners are sharing the common vision with NCS in improving quality of care for critically ill patients with neurologic disorders.

During this one and a half day long meeting, 22 lectures will be presented including recent update of status epilepticus, management of subarachnoid hemorrhage, multimodality neuromonitoring, and the clinical application of targeted temperature management in various neurologic conditions. There will be 14 international invited speakers including two NCS officers (Drs. Jose Suarez and Gretchen Brophy) and 100 participants already pre-registered.



South Korea: Asian Chapter Meeting Program committee members from Korean Neurocritical Care Society



Acute Neurological Care at University Teaching Hospital in Lusaka, Zambia

By Jacob Manske, MD, and Teresa Lee, MD

The University Teaching Hospital (UTH) in Lusaka, Zambia, is the largest hospital in the country. With over 1,600 beds, it serves as the main referral hospital and trains many of Zambia's medical students, residents and nurses. Through a partnership with several American neurologists working at UTH, Rush University Medical Center (RUMC) in Chicago began sending two neurology residents per year to work for a month at UTH in 2017. Drs. Jacob Manske and Teresa Lee, currently fourth year neurology residents at Rush, were the first residents selected for this opportunity.

The month was primarily spent consulting on patients with neurologic problems hospitalized on the various medicine wards and in the intensive care unit (ICU). With only 10 adult ICU beds, the intensive care unit was primarily reserved for patients who required mechanical ventilation. Ischemic and hemorrhagic stroke patients were typically monitored on the regular medical wards. In many cases, a computed tomography (CT) scan took several days to perform. Similarly, laboratory studies performed would often return several days later. A common dilemma for acute stroke patients was the decision to give or withhold aspirin prior to CT. This was challenging, as typically in the U.S. we would be able to wait for CT results in order to determine if the stroke was hemorrhagic or ischemic. In cases of significant headache, coma, seizures or severe hypertension, we were more likely to hold aspirin. Given these limitations, the overall experience was incredibly beneficial to the development of our history taking and physical exam skills.

With an HIV prevalence of 11.5 percent among adult Zambians¹, we cared for patients with neurologic complications not commonly encountered in the United States. This included cryptococcal, bacterial and viral meningoencephalitis, as well as varying presentations of tuberculosis, neurocysticercosis, progressive multifocal leukoencephalopathy (PML) and toxoplasmosis. In developing a differential diagnosis, the single most important history detail was an individual's HIV status.

In addition to patients with vascular and neuro-infectious diseases, we treated many patients with epilepsy. The most

commonly used antiepileptic medications were carbamazepine, phenobarbital and diazepam due to cost and availability. Levetiracetam and phenytoin could be used if the patient or family had financial means. During our time, a medical student from the United States was performing epilepsy research at UTH and acted as an electroencephalogram (EEG) technician.

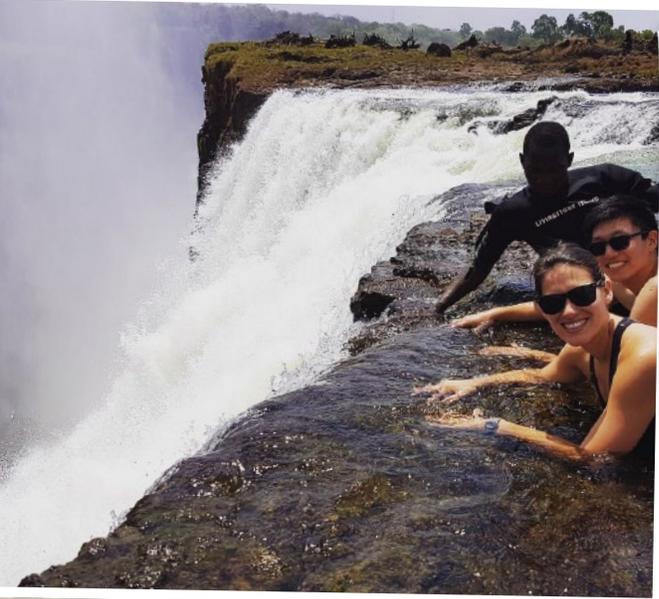
Aside from clinical practice, a large portion of time was spent teaching neurology to medical students and residents. We gave lectures on many subjects including the neurologic exam, acute stroke, management of seizures and neuro-infectious diseases. We performed bedside rounds with students, teaching physical exam and localization skills. Residents and students also attended neurology clinic with us one day per week to learn about outpatient neurologic problems.

The trip also afforded us the incredible opportunity to explore a new area of the world. Highlights included a trip to Victoria Falls (the largest waterfall in the World), a safari in South Luangwa National Park and visits to the local markets in the capital city of Lusaka.

Beginning in 2018 with the support of Drs. Omar Siddiqi of Beth Israel Deconess Medical Center and Igor Koralnik of RUMC, UTH now has its own neurology residency program. Future residents from RUMC rotating at UTH will have the opportunity help train and learn from these new residents.

Reference

1. <http://www.unaids.org/en/regionscountries/countries/zambia>



Regional Meeting in Dubai

By Yasser B. Abulhasan, Chairman, Neurocritical Care-MENA Chapter of IPACCMS, and Hussain N. Al Rahma, President, IPACCMS



Yasser B. Abulhasan



Hussain N. Al
Rahma

It is a great pleasure to welcome you all to the first Regional Neurocritical Care Meeting in the Middle East and Africa, which was developed in partnership between the International Pan Arab Critical Care Medicine Society

and the Neurocritical Care Society as part of the 15th Emirates Critical Care Conference (ECCC) on April 4-6, 2019, in Dubai, United Arab Emirates (www.eccc-dubai.com).

There will be a highlighted full day neurocritical care track (April 5) presenting topics and practice updates that will cover ischemic stroke, intracranial hemorrhage, traumatic brain injury management, challenges in diagnosis, general critical care and prognostication of the neurological injured patient. Courses and workshops will include an Emergency Neurological Life Support course (April 4), a Determination of Brain Death workshop (April 6) and an Introduction to Transcranial Doppler workshop (April 6). Original accepted abstracts relevant to basic, translational and clinical research in neurocritical care will qualify for publication in the *Neurocritical Care* journal. Additionally, a newly developed award will be presented at the meeting for the outstanding scientific abstract presented at the conference. Online abstract submission is currently open at the conferences website.

To facilitate a stronger international neurocritical care presence, please join us in Dubai, April 4-6, 2019, to mark the achievement of this milestone, promote multidisciplinary quality patient care, discuss research ideas and develop professional collaborations.

Literature Review

By Kyle Hobbs, MD, and Sara Stern-Nezer, MD

Due to their efficacy and favorable rates of complications when compared to vitamin K antagonist therapy, direct or novel oral anticoagulant (NOAC/DOAC) use is now widespread, and reversal agents exist for many of these medications. The studies reviewed below analyzed how different disease outcomes (traumatic brain injury and subdural hematoma) were affected by the use of DOAC therapy.

The novel oral anticoagulants have worse outcomes compared with warfarin in patients with intracranial hemorrhage after TBI.
J Trauma Acute Care Surg 2018; 85: 915-20.

Summary: NOAC use in trauma patients is becoming increasingly prevalent, but with limited understanding of effect on outcomes in the TBI population. This single-center observational analysis of prospectively collected data included all adult trauma patients admitted with a diagnosis of traumatic brain injury (TBI) who had intracerebral hemorrhage (ICH) on initial head CT and were taking preinjury oral anticoagulants (warfarin, direct thrombin inhibitors, or Xa inhibitors). Patients were stratified by type of preinjury oral anticoagulant (warfarin vs NOAC) and by severity of TBI. Propensity score matching was performed for the two cohorts in a 1:2 ratio (NOAC:warfarin). NOAC patients had a higher Injury Severity Score (ISS) on admission. After propensity score matching (70 NOACs, 140 warfarin), mean age was 58.7 ± 15.2 years, 67.6% male, median GCS 14 (IQR, 8-15), with falls being the most common mechanism of injury. In the NOAC group, 54% were taking oral Xa inhibitors and 46% were taking dabigatran (direct thrombin inhibitor). There were no differences in demographic characteristics, comorbidities, mechanism of injury, GCS on admission, or rate of epidural, subdural, or subarachnoid hemorrhage. 58% of patients were taking antiplatelet agents in addition to their anticoagulant, evenly matched between the two groups. NOAC patients had higher rates of progression of ICH on repeat CT scan ($p=0.03$), neurosurgical intervention ($p=0.04$), longer ICU length of stay ($p=0.04$), and higher mortality ($p=0.04$). There were no differences in hospital length of stay or discharge GOS-E. Subanalysis showed that mild and moderate TBI patients were significantly more likely to be discharged to rehab/SNF, and had higher mortality and need for neurosurgical intervention, while these differences were not significant for patients with severe TBI.

Commentary: This study showed worse outcomes in TBI patients who were being treated with NOAC therapy when compared to patients taking warfarin. This analysis has limited generalizability as it was a single center study, and the reason for anticoagulation was not included; however, the propensity score matching did attempt to account for confounding variables between groups. Data was lacking on the reversal agents used in both the NOAC and warfarin groups, which likely had an impact on progression of hemorrhage, as did the relatively high rate of concomitant antiplatelet use. Further study in this population is needed, particularly with the approval of adexanet alfa.

Improved outcomes in patients taking DOACs over VKA in acute subdural hemorrhage.

Neurocrit Care 2018; epub ahead of print.

Summary: While therapy with vitamin K antagonists (VKA) has been shown to worsen outcomes in acute SDH, there is little data on the effect of DOAC therapy in this population. This single-

center retrospective analysis included all patients treated for acute SDH who were on DOAC or VKA therapy on admission. Patients with purely chronic SDH were excluded, but acute on chronic SDH was allowed. The neurosurgical consultant determined whether to administer pro-hemostatic substances and/or perform operative intervention. Prothrombin complex concentrate (PCC) was administered in the majority of cases, as well as IV phytonadione if patients were on VKA therapy. 128 patients were included (65 DOAC, 63 VKA). PCC was administered more frequently in the VKA group and at higher mean dose. Patients with VKA had a lower GCS score on admission, fewer VKA patients had GCS 13-15, and more VKA patients were intubated prior to hospital arrival. Recent trauma was reported more often in the DOAC group (89% vs 60%, $p<0.001$). There were no significant differences in the rate of rehemorrhage in the DOAC group, and overall 30-day mortality was the same for DOAC vs VKA (26% vs 27%, $p=1.00$). Rate of neurosurgical procedures was not significantly different between groups. DOAC patients had significantly higher Glasgow Outcome Scores (GOS) at hospital discharge, and mean hospital length of stay was shorter (5.9 vs 7.2 days, $p=0.024$). Only 7 DOAC patients were taking dabigatran, of which 4 (57%) received idarucizumab, with no deaths at 30 days. One patient on apixaban who received PCC on admission died of an ST-elevation MI 5 days later.

Commentary: This study suggests that patients on preinjury DOAC therapy may have improved outcomes compared to those taking VKAs in the event of acute subdural hemorrhage. While mortality was the same between groups, the DOAC group had shorter hospital LOS and better 30-day outcomes, as well as similar rates of neurosurgical intervention and rehemorrhage compared to warfarin. This study is limited in its small size and that it was conducted at a single center. In addition, there was imbalance between groups on admission, with higher mean admission GCS scores in the DOAC group and lower rates of prehospital intubation. It is possible, however, that the benefit seen from being on DOAC therapy would have been higher with andexanet alfa for Xa inhibitor reversal, as only 58% DOAC patients received PCC in this study. Whether andexanet alfa use translates to better clinical outcomes remains to be seen.



The Neurosciences Intensive Care Unit at Mayo Clinic Saint Marys Campus

By Eelco Wijdicks, MD, PhD; Alejandro Rabinstein, MD; Sara Hocker, MD; and Jennifer Fugate, DO
 Division of Critical Care Neurology, Mayo Clinic, Rochester, MN



Eelco Wijdicks, MD, PhD



Alejandro Rabinstein, MD



Sara Hocker, MD



Jennifer Fugate, DO

The Neurosciences Intensive Care Unit (neuro-ICU) at Mayo Clinic Rochester was arguably one of the first combined neurology-neurosurgery intensive care units in the U.S. The idea to build a dedicated neuroscience unit in Saint Marys Hospital originated with the Sisters of St. Francis, who recognized that patients with severe traumatic brain injury and post craniotomy required very close neurological monitoring. The Mayo Clinic quickly honored

the Sisters' devotion to patients, and in 1958 the neuro-ICU opened in Saint Marys Hospital. There was a strong impetus to train nurses in the more complex care of these patients. As was the case with virtually every intensive care unit in the country, these units were initially open. However, in 1993, a more organized plan of care for all critically ill neurology patients began in the 20-bed neuro-ICU to provide close evaluation and co-management of selected neurosurgery patients.

Over the last two decades, there have been gradual but important changes. The neurocritical care group provides a primary service with a number of major responsibilities. First and foremost is the care of the critically ill neurologic and neurosurgical patients, from A to Z, from top to toe, from ICP to SCD. A devoted team, led by a 24/7 neurointensivist, provides close bedside care with a major emphasis on the clinical neurologic manifestations of deterioration and specific treatment of a number of major neurologic emergencies. The model of care in our neuro-ICU is closed: all orders in patients under our care are written by our team, in agreement with neurosurgery when pertinent. Anesthesia support is available for supervision of invasive procedures, but

procedures are performed by the neurocritical care fellow. All admissions to the neuro-ICU are selected on the basis of the acuteness of the neurologic condition. All stroke patients with large-vessel occlusions requiring endovascular intervention receive specialized neurocritical care. Major acute stroke care is provided by the neurocritical care team, which is physically in the radiology suite examining the patient, interpreting the CTA and CT perfusion scans, and remaining on-site during the procedure to provide additional decision making in conjunction with the interventionalist. Currently, all critically ill neurosurgical patients are under the close care of the neurointensive care team. The neurointensive care team also manages patients in the emergency department before they are admitted to the unit—closing the commonly perceived gap between care in the ED and neuro-ICU.

A unique component of our division is a separate hospital service that provides acute neurological consultations to all other surgical and medical adult intensive care units including general medical, general surgical, cardiovascular, general trauma, transplant and oncology cases. This has allowed us to develop expertise in the neurology of critical illness with its constantly changing challenges (from early transplant-associated neurotoxicity to ECMO and CAR-T treatment).

Mayo Clinic's Rochester campus has four neurointensivists who share call. (A fifth neurointensivist will join our division in 2019.) The rounding team consists of the consultant, neuro-ICU fellow, a day and night resident (12-hour shifts), nurse practitioner or physician assistant, neurology ICU pharmacist, charge nurse and clinical nurse specialist. Our neurointensivists have a strong academic record, and all have published and been cited extensively. We participate actively in research including participation in clinical trials. We have a research coordinator dedicated to our ICU.



Overview of the neuro-ICU as part of two towers that house all ICUs and rehabilitation and a stone's throw away from the Emergency Department (seen in front of the towers).

For many years, we have had a fellowship program. Under the guidance of the consultant, the fellow is directly responsible for the care of patients with acute neurological emergencies. Our fellows have exposure to all forms of neurologic emergencies such as traumatic brain injury at a level 1 trauma center, acute ischemic stroke, including endovascular treatment, intracerebral hemorrhage, subarachnoid hemorrhage, coma, status epilepticus and acute neuromuscular diseases, among many other challenging complex disorders. Our fellows learn to manage systemic consequences of complications from acute neurologic injury but also receive full training in general critical care working with other critical care fellows during their several rotations in other surgical and medical ICUs. Before starting their clinical rotations, our fellows participate in a mandatory "boot camp" to learn all necessary procedures and the basics of ICU care. The fellows must also direct end-of-life care conferences and family communications. Moreover, they are asked to lead the consultative neurocritical care service when not serving as the fellow in the neuro-ICU or rotating through the other ICUs. Fellows also staff acute neurology cases seen by senior residents in the emergency department throughout the second year of fellowship and lead rounds. We have deliberately decided to open only one position per year to ensure that our fellows receive the best possible training and the optimal degree of mentorship. (Eager and energetic fellows can expect a good boost to their CV.)

We enjoy a cordial, collegial relationship with the nursing staff and other allied healthcare workers; all of us are fully congruent to Mayo model of care. We all tremendously enjoy our work, treasure our long friendships, and strive to provide the best outcome for patients in the midst of a major acute event. We closely support distressed families whose loved ones are admitted to the unit and prepare them for possible secondary complications and offer realistic predictions of the recovery trajectory. When recovery is unachievable, we facilitate palliative and pastoral care. We have all the proven and tested technology available to us, but we stay true to our neurology roots, which drives our decisions. At Mayo Clinic, the practice of neurocritical care is part of our fabric, it is something that is always there, and we are proud to do it.



Stories of Hope:

Ayanna



Lindsay Marchetti,
RPA-C, Lead APP,
NMICU



Kathryn Zelazny,
RPA-C



Betty Rosabal,
LMSW



Chris Zammit,
MD, FACEP



Michael Reznik, MD

Contributors: Lindsay Marchetti, RPA-C, Lead APP, NMICU¹; Kathryn Zelazny, RPA-C¹; Betty Rosabal, LMSW¹; Chris Zammit, MD, FACEP, Assistant Professor of Emergency Medicine, Neurology, Neurosurgery, and Medicine^{1,2}

Section Editor: Michael Reznik, MD, Assistant Professor of Neurology & Neurosurgery, Alpert Medical School, Brown University/Rhode Island Hospital

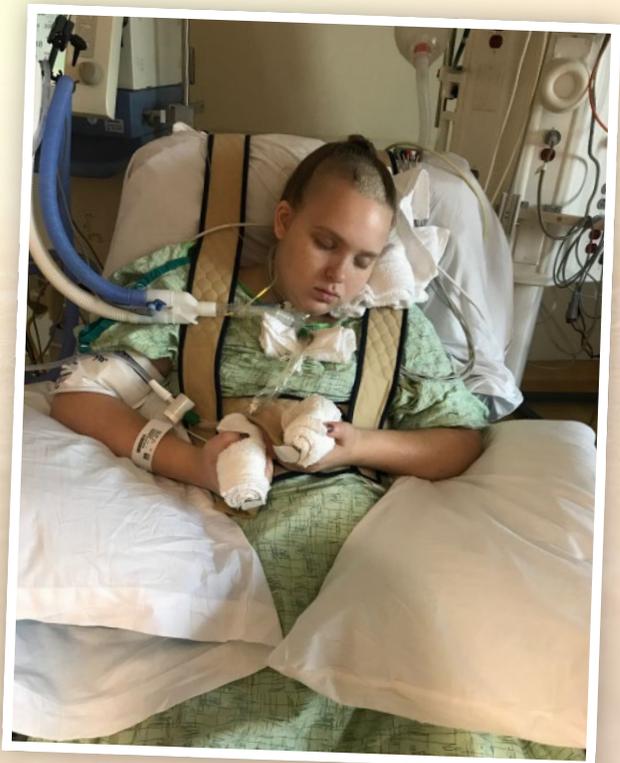
Ayanna was a young woman on a mission, on her way to the gym for a workout in preparation for boot camp with the United States Marine Corps (USMC). She was days away from starting her senior year of high school and had already come up with very specific and carefully considered post-graduation plans. Athletics came naturally to her as an avid and competitive cheerleader, and she knew she wanted to serve in the USMC; she also hoped to attend college at Old Dominion, and eventually planned to become a paramedic.

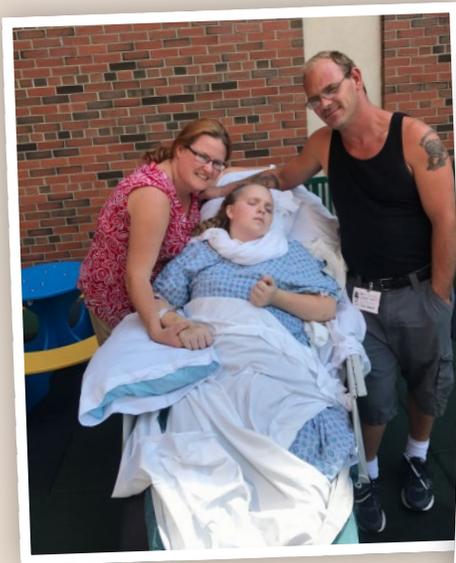
The Things Nightmares Are Made Of

Ayanna never made it to the gym that day. Instead, her car veered off the road, crossed the right shoulder, and crashed into several trees before finally coming to a standstill. Ayanna was left unconscious behind the steering wheel. A driver not far behind her happened to be a local nurse who stopped and immediately recognized the seriousness of the accident, calling emergency medical services to come to the scene. EMS was rapidly mobilized, and on their initial assessment, Ayanna was indeed unconscious. She was also unable to breathe adequately, so the paramedics placed a breathing tube and emergently brought her to the area's Level 1 trauma center.

When the medical team at the University of Rochester Medical Center's Emergency Department assessed Ayanna, they found that she was in a coma, with involuntary reflexes representing her only signs of active brain function. A head CT was done, which showed that she had suffered a small subdural hematoma and some traumatic subarachnoid hemorrhage—that is, some bleeding around her brain but no obvious bleeding in the brain tissue itself—and probably not enough to explain her severe impairments. CT scans of the rest of her body were also done and showed that, although Ayanna had suffered a severe traumatic

brain injury, she luckily had not sustained any serious injuries to any other parts of her body. She was subsequently admitted to the Neuromedical Intensive Care Unit (NMICU), where she underwent intense monitoring and management of her intracranial pressure and cerebral oxygen levels.





“Seeing Ayanna was . . . the things nightmares are made of for Moms,” said Ayanna’s mother, Tanya, as she reflected on seeing her daughter in the hospital. For her first week there, Ayanna remained unconscious, and her prognosis was very much uncertain. When Ayanna eventually did get an MRI of her brain done that week, it brought grim news, showing that she had evidence of grade 3 diffuse axonal injury—the most severe type of shear injury to the nerve fiber connections in her brain—a finding that explained why she remained in a coma.

Then, after one week in the NMICU, Ayanna began to turn a corner. She started to have more than just involuntary reflexive movements of her body, as she began to show signs of using her right arm in a purposeful, voluntary fashion. Slowly, signs of consciousness began to follow, but as she started to become more awake, it became clear that her left arm and leg remained severely weakened. The axonal injury visible on Ayanna’s MRI—the tearing and stretching of nerve tissue caused by the whiplash and shaking her brain endured during the accident—unfortunately corresponded to the parts of her brain that helped move her left arm and leg. It was to be the beginning of a long, and still ongoing, road to recovery.

A Young Woman on a Mission

After Ayanna had a tracheostomy and feeding tube placed, she was able to be liberated from the mechanical ventilator and more easily and safely mobilized out of bed. In short order, Ayanna was off the ventilator and breathing on her own through the tracheostomy. Medications called neurostimulants were initiated to improve her



wakefulness. By the end of her NMICU stay, Ayanna’s nurses were gladly painting her fingernails and toenails to help perk her up, and were bringing her outdoors to enjoy some of the afternoon sun.

Like many other survivors of severe brain injuries, Ayanna did not remember any of her stay in the NMICU, and to this day still has no recollection of it. Three weeks after her accident, Ayanna transitioned to acute rehab, where she would get full-time physical, occupational and speech therapy. She was still not speaking yet and had just regained the ability to perform simple tasks when instructed; and though she was getting helped out of bed, she was still not able to walk or stand. But her progress was quick, and within one week of being in acute rehab, Ayanna had begun to speak; three days later, she had her tracheostomy removed and began eating soft food. In another eight days she was eating regular food that she could chew on her own, and was able to stand and walk with the support of two people. Thirteen more days—a total

of 52 days after her injury—and she found herself being able to move her left leg on her own again. “I fully remember the day I moved my left leg for the first time,” Ayanna now says as she’s able to think back and reflect on the moment. “I remember thinking, ‘I am going to walk. I am going to walk. I can do whatever I put my mind to.’”

Around this time, Ayanna also began reading about recovery from traumatic brain injury, taking a particular interest in the concept of “neuroplasticity.” She asked for a tutor to help her keep up with high school because she was intent on graduating on time, and she made a goal of being able to walk out on the football field with the other senior cheerleaders on her high school’s senior night, which was to take place 75 days after her injury. Keeping true to her plans, Ayanna was discharged from acute rehab on senior day and walked out onto that football field, just as her fellow cheerleaders did, with her mom and dad at her side. And four months after her injury, Ayanna returned to school, eventually finishing the school year as scheduled and graduating from high school together with her class.



Finding Strength, Finding Happiness

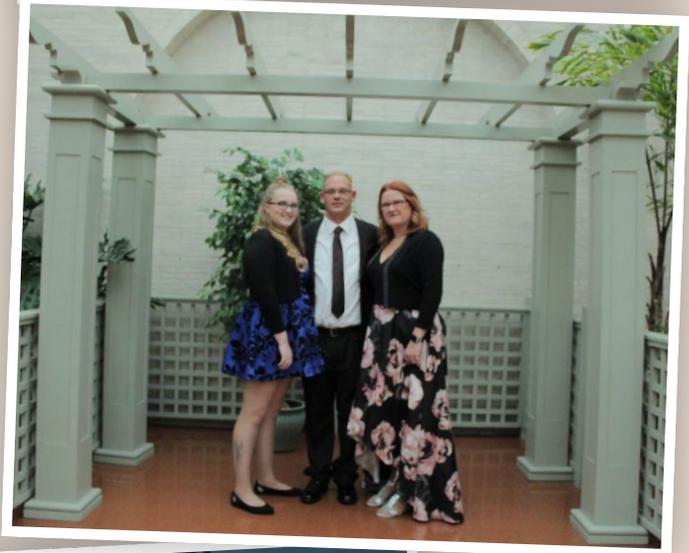
While Ayanna and her parents are delighted and grateful for the recovery she's made, the process hasn't been without its struggles. The whole ordeal occurred while Ayanna's mom was in the midst of completing nursing school, and her dad left his job to help care for her after she had been discharged from rehab. This left the family in a period of financial difficulty. To make matters worse, when Ayanna returned to school, she experienced bullying and insensitive comments from other students.

One year after her accident, Ayanna is able to walk unassisted, but she still has lingering weakness and stiffness in her left arm and leg. While she remains deeply committed to her prescribed exercises to improve her strength and tone, they often come at the expense of spending time with her friends, and she finds her social life strained as a result. To her great disappointment, she also learned that regardless of any further recovery she makes, she will never be able to join the USMC because of her disability, and she recognizes that she can't become a paramedic either until she is able to use her arms and legs fully. Finally, she has had unexpected issues with her voice, having remained hoarse since her accident, and it was discovered that she had sustained an injury to her vocal cords. As a result, she is no longer able to sing, something that had once been a passion for her prior to her injury.

Through all these struggles, Ayanna has had to battle through periods of sadness, disappointment and depression. But despite these challenges, Ayanna has developed profound resiliency. "I was going into the Marines to prove that I was strong," Ayanna says, speaking of her lost opportunity to serve in the USMC. "I am not weak. I am *not* weak. I proved it, just not through the Marines." Even though she says she is proud of herself, she adds: "As a young girl, going from doing anything I wanted to needing pretty much help for everything is quite difficult, but it gets better. Because I went from being in a coma to now being able to talk to you, and walk, and sit in a normal chair—and that in itself makes me happy."

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1. University of Rochester Medical Center/Strong Memorial Hospital
2. University of Rochester School of Medicine & Dentistry



Neurocritical Care Society (NCS) Asian and Oceanian Chapter Annual Meeting 2019

米国神経救急・集中治療医学会

アジア・オセアニア支部年次学術集会2019

~Neurocritical Care in Asia and Oceania without Borders~



Session
会期

June 8 (Sat) ▶ 9 (Sun), 2019

Venue
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Osaka Medical College and Kyoto

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会長

Masao Nagayama (International University of Health Welfare (IUHW) Graduate School of Medicine)
永山 正雄 (国際医療福祉大学大学院教授 国際医療福祉大学熱海病院副院長)

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The cover art was submitted by Lauren Koffman, DO, MS, a neurointensivist at Rush University Medical Center in Chicago. The view is along a path within Morton Arboretum, located in the suburbs outside of Chicago.