

**AARTI SARWAL:** Rita asked me to put together a presentation basically to give you a perspective of neural critical care unit on the whole spectrum of continuum of care of patients with stroke. Now I see many familiar faces here, but just to get a sense for the audiences, how many of you are actively taking care of stroke patients in some clinical capacity at this point? Pretty much all of them.

How many of you are physicians? How many of you are nurses? Wow, OK, awesome. And how many of you are physical therapists or occupational therapists? Speech therapists? EMTs?

Awesome. Anybody else I'm missing? Pharmacy. How could I miss that? Darnit. OK.

So neural critical care speciality is basically taking care of life threatening brain injuries. Stroke happens to be one of them. And we kind of get hidden in the whole spectrum of care, and the other kind of doctors that patients don't remember and should not remember, if we're doing a good job. And by the time a patient start recognizing us and interacting with us, it's time to get out of the ICU.

I have no disclaimers, I do have my own implicit and explicit biases, and for the sake of everybody's sanity we will not make any political comments. This is my implicit bias. I do think that you're all just as smart, funny, and intelligent.

And I do tend to talk very slow. So if I do over bore you with the speed of my speech, just raise your hand and ask me to slow down further. And you must have noticed my South Carolina accent. So either way, bear with me as I give you a little perspective of my life taking care of these patients.

So what I'm going to try and do as a part of this presentation is give you what we do and give you a perspective of what it means to be a neurointensivist-- the challenges, the perspectives, why our quirks and our perceptions towards taking care of these patients are a little different, to the point we brag that we really are passionate in taking care of this very particular subset of patients. And as I go through that, I would like to make you aware of a few challenges that we have in the ICU care of these patients. And these challenges are inherent of our clinical practice, across all specialties-- and how these challenges actually affect therapeutic decision making as offering therapies, of accepting therapies in these patients, and eventually makes a difference to the outcomes.

And as I do that, I'll try to walk you through a few cases that I have personally taken care of. Most of these cases are what we call as cheating death cases. I wish those cases happen on a daily basis, but they don't. But they're the kind of cases that help me show up to work, even on bad days. So the other cases we'll be going through.

So what basically neurocritical care unit does is it's a primary or secondary, "critically ill," neurosurgical or neurological patient that requires ICU. And you tend to cohort all these patients in a single unit. And like any other thing, if you do something again and again, and if you do different varieties of the same thing, you get really good at doing that. That's pretty much what Neuro-ICU does. It's inherently multi-professional. There is not professional, by themselves, that can take of all these patients. There are patients with aneurysms. There are patients with bad spine problems. There are patients with bad strokes. There are patients with bleeds. There are patients with various kinds of brain edemas. And you need different kind of new surgeons, different kind of neurologists, different kind of ICU doctors to take care of these patients.

Even if as doctors you did a good job of getting together a team of specialists, you still need a lot of other people who help you carry out that care, like Neuro-ICU nurses. The holy grail of Neuro-ICU monitoring is clinical exam by a neurological nurse, which is better than any CT scan, MRI in picking up a neurologic deficit or a change in neurological exam. And picking that up timely, and intervening, is pretty much the holy grail of ICU. Even if you pick it, we fix it, and the patient does not get any further brain injury, there are lots of people who help us on the road to recovery-- speech therapists, occupational therapists, nursing assistants, respiratory therapists, pharmacists-- that are indispensable to the care of these patients.

And our unit represents probably one of the fewer medical subspecialties where the multi-professional group is very integrated. And they have to work on a daily basis. So on a daily basis, one patient may have a neurosurgeon, a neurologist, an epileptologist, a Neuro-ICU doc-- all four people making decisions on that patient. And our science basically epitomizes the inherent specialization of each of these components of these brain injury patients.

And you still try to provide individualized care. And most of our guidelines-- by American Heart Association, American Stroke Association, or any other national societies-- are very consensus based. We don't have much literature on our science. We've been around, as a science, for around 25 years. As American society, the Neurocritical Care Society has been around since 1995. But despite this being 2016-- and I'll show you. I have two slides that sum up everything we know about brain injury and care of stroke patients from ICU perspective.

We do think that making this model-- of multi-professional, dedicated people who are highly integrated and talk to each other on a daily basis-- it does create a better understanding of the problems that the patient's facing. And we use that knowledge, the science, basically to bring up some strategies that seem very reasonable and rational for that patient. We can't tell you that there's an evidence base to it, there's a trial to it. But it makes sense, based on what we know about the patient's condition and the pattern physiology of the disease, to the point that there are other specialities that say Neuro-ICU's a voodoo medicine. But so be it.

So we take care of a very big range of patients. If you're familiar with looking at CT scans, this pretty much represents the whole range of stroke patients that I see. Now when we say stroke in a layman's term, usually people end up thinking of a clotting stroke, or what we call is acute ischemic stroke. But in scientific terms, stroke would have many varieties. So you could have a very early ischemic stroke that doesn't show on the CT scan yet. This is a full-blown MCS stroke, that has shown significant cytotoxic edema of the right side of the brain. You've got hydrocephalus, subarachnoid neural hemorrhage, intraventricular hemorrhage, subdural hemorrhage, an epidural hemorrhage, or intraparenchymal hemorrhage. See, they're pretty much the big varieties of stroke that we see, but a whole range of presentation based on what the patient comes with and what the side effects of that stroke itself is.

And this is one of the slides that pretty much represents everything I do. So if you read all this-- picking and choosing which one I do in which patient is the science behind it, or the practice behind it. But this pretty much represents everything we do in a stroke patient. For the very acute therapies, we have reperfusion. You all know about TPA and intravascular procedures to do thrombectomies and clot retrievals, to help reperfuse a stroke. These therapies are only available between three and 4.5 hours for TPA, and up to six to eight hours for endovascular therapies. If it's a bleed in the brain, we tend to evacuate it. If it's subdural, if it's epidural, or a big IC-- it's causing mass effect-- we can surgically take it out. Or we can take the skull off, to reduce the edema from the bleed itself. We can put an EVD into you, to take care of the hydrocephalus.

Medically, we can hyperventilate you. And we can give you osmotic therapy-- which could be mannitol hypertonic saline-- to decrease ICPs. And beyond that, all we do is take care of your ABCs. And the one big thing that we do differently than most other clinical care units is BP modulation. So we pick and choose what BP parameters to follow, based on what condition do you have.

If we have numbers, we try to keep your ICP less than 20. CPP-- cerebral perfusion pressure-- more than 60. MAP more than 65 is the minimum we try to keep in all ICU patients. But we may raise your MAPs in the ICU if you have a vasospasm from subarachnoid, or if you have a perfusion-dependent stroke. Or we may drop your pressures if you have a bleeding risk, depending on the kind of bleed you have. We try to keep you normal thermic. We try to keep your glucose normal. We try to keep your head of the bed up, to maximize venous outflow without compromising arterial blood flow to the brain. And beyond that, there's really-- there are lots of trials, lots of other things we can do. But this literally sums everything I do in any stroke patient to better take care of them.

And like any other place, which will have a big multidisciplinary team, everybody has their quirks. Everybody has their personalities. Everybody has their passions. And I haven't been able to find an American corresponding team for that. But if any of you are familiar with Tintin-- some of you are nodding. So Tintin is basically a news reporter. It's a European comic book that I grew up on. And the characters of Tintin, in my eyes, basically represent a typical Neuro-ICU team.

You've got this bright, young news reporter, who was born yesterday, and knows his science, and really wants to change the world. And you've got this Professor Calculus, with the green coat, who is very wise, has seen the world, so has years of experience behind him. May not be that [INAUDIBLE] to the new world, so he's hard of hearing, but really the one person you go to when you don't have answers to a question. And then you've got Captain Haddock, the captain in the blue shirt, who is cynical, abrasive. And every Neuro-ICU team has one of them, dependent on the speciality they are-- thinks that the world revolve around them, and basically wants to get things going a certain way, because he said so.

And then there are these two detectives, who are twins, and the black suit. There are Thompson and Thompson, who are all these other clinical providers, who basically try to be a part of the team always. And the team forgets that they are part of the team. So they literally have to chase around people to say, hey, guys. We're trying to do something. And I sometimes feel we do that to nurses, respiratory therapists, and other clinical providers in the unit-- that they're indeed a part of our team, but we don't really make them a part of us. And then, obviously, the opera singer, who basically wants the center of all attention. In my case, she's the case manager, who basically decides, at the end, what happens to my patient, then basically dictates how long they stick around with me.

So throughout this whole continuum of care, you guys represent-- this whole room represents-- the whole continuum of care, and the whole sense of this conference, that a stroke patient, no matter what kind of stroke they have, goes from pre-hospital, ER, OR, ICU, inpatient, outpatient. And there are different people who touch the stroke patient at that time, make decisions-- with and without patients' or families' input. And all these people have the potential of making some decision that can impact patients' outcome.

And to give you how we look at-- when we come up with a speciality, with so many people involved, so many transitions of care involved, so many handoffs involved, what structure do we look for when we say to set up this new speciality? Well, at the bottom line, we need to have dedicated providers, who have resources-- time and support-- to take care of these patients. That represents this room. We want vested, continuous care. And as I will talk in the next few slides, and elaborate with the cases, vested, continuous care has been a very difficult thing to do in my unit. When I say-- my unit means my science, not Wake Forest Baptist itself. Many people have disbelief in outcomes of brain injury patients. They don't think the patients do well, so they don't get taken care of, and hence, they don't do well, and ends up being I said so.

Continuous care-- because of so transitions involved, there are so many places where that sense of lack of investment in the patient's outcome can fall through the cracks. A homogeneous population-- our population is very different. The same stroke that is right MCA may behave differently in a 23-year-old guy who had carotid dissection while playing basketball, or a 45-year-old female who is homeless, takes cocaine, has made some poor choices in life, and ended up having a cardioembolic stroke, versus a 75-year-old guy who takes very good care of himself, never drank or smoked anywhere in life, and just happened to have high cholesterol that keeps on giving him cardiovascular events.

And making any trial, making any clinical paradigms, in these three populations, that equally apply to all three, is very difficult. What may work in one may not work in others. And we don't have visible response in time. When you, say, fix somebody's gallbladder, the very next day, the pain goes away. If you fix somebody's sinuses, by a week, you're feeling awesome. That real time response to what we do doesn't happen in our care. We take care of patients with the hope that they get better. Some do get better. Some don't. But the ones who get better take months to get better.

It's almost like you went on a vacation. You came back. And your plants look dead. You don't know if they're dying, or they're dead. If you uproot them and put them in the trash, they're dead. But you just hope that if you water them, you give them fertilizer, you water them, it takes a few days for them to spring up. But for a few days, they look dead. So our patients look like that for a very long time. And that is very hard to accept, as a clinical provider, who's very passionately taking care of these patients, in a very high-strung environment.

Evidence-based medicine has failed us. We apparently don't have any randomized trials that really give us clear instructions in most of our patients. And even the trials that are very small-- level C or level D evidence, as we call them. Lots of our science is based on observation. We see it works. It seems like it works. So we keep on doing it, until we see something else that doesn't work. And then we start questioning. And then we changed it. And most of our practice is based on our knowledge of pathophysiology-- thinking that this is how we know brain works, and this is how our-- and that's the basis of our clinical management paradigms. That's why we don't call them protocols. We usually call them clinical guidelines, care pathways.

And to give you a spectrum of how our attitudes-- and these challenges of practicing-- the ICU care of these patients hasn't really changed in 125 years. In 1890s, we still had patients who were being diagnosed with stroke, hemorrhage, based on basically clinical diagnosis. There were no CT scans or x-rays at that time. You came with hemiplegia syndrome. And the doctors thought that you had cataplexy or apoplexy. And they basically put you in a nursing-- they were not even infirmaries at that point. They basically sent you back home. And if you deteriorated further, they'll take you to a basement.

And there were neurosurgeons at that time-- if you've heard of Monroe, Kelly, Osler-- who basically would do a subtemporal decompressive skull resection, without anesthesia. Remember? Ether wasn't invented until 1920s. And they'll basically pop it out. And if it pops out as a bleed, you said, hey, I found [INAUDIBLE]. And patients still survived at that time. But one of Ostler's journals very clearly states that the friends and the family should very clearly be told at the onset, when a patient comes with cataplexy, that he's not going to do well. And this was 1892.

And in 2001, the three big stroke trials were reported, which talked about ICH mortality, and three different interventions to take care of ICH, including surgical and medical. The biggest reason why these trials have never translated into clinical medicine-- 3/4 of the patients in these trials, which were being monitored by science people-- everybody was invested in these trials. NIH was interested. But 3/4 of these patients died, not because of the therapies, or lack of therapies-- from withdrawal of care, conscious decision by the providing team and the family. So we will never know if these therapies worked or not.

In 2005, our severe stroke mortality-- if you had a stroke, and you were on mechanical ventilation, we still had 1/2 to 3/4 of the patients dying at 30 days, despite all the care that we provide. And 1/3 may survive to minimum disability. But there were no factors that we could predict at that time. Until 2005, people from the EMT world and ER world that know the history of TPA, the American College of Emergency Physicians still advertised on the big banner on their website that they highly recommend against TPA. And that is not standard of care.

And that bias still persists in some small communities. And 40% of the people that were surveyed in 2005, who were ACEP members, basically indicated that they will not use TPA, or even offer TPA-- something that we now know is the holy grail of acute stroke management. And you will think that maybe last 10 years we made some progress. But in 2011, there was a good study that basically went back and looked at patients cold status being changed. And 1/2 of the stroke patients admitted to any hospital-- whether you're a community, whether you're a big academic hospital-- they were made DNR on admission.

So they were not even given 24 to 48 hours to see what comes, to the point that without evidence, AHA had to come out with a statement say, guys, at least take care of these patients for 48 hours before we address cold status. If it really look bad, the family doesn't want to do anything, it's a whole different thing. But if the family wants to pursue, give them a chance. And the patient has a clinical profile that looks like it's not quite sure which way they'll go, give them 48 hours before they address the cold status. And that's part of the ICH and stroke guidelines at this point, that we're highly discouraged to address cold status in a patient in the first 48 hours, without attempts to save.

And that phenomena of our biases and attitudes has actually been scientifically researched and published as a phenomenon-- what we call as therapeutic nihilism. We think you look bad. So we tell you, you look bad. We tell the family, oh, he looks bad. Do you want us to do something? Family says, no. He would never want that quality of life. So we say, withdraw care. Hence, he and say, see? I told you. It's as simple as that. But we don't sometimes understand how much that bias has contributed to mortality in our science, and how much that prohibits us from taking care of certain things because it has not allowed us to do good trials. And the self-fulfilling prophecy has limited our ability to progress in developing clinical paradigms.

Plus, most of our science is voodoo. Like it or not, accept it or not, we see something happens. We do it for a few years. And then we start understanding the science behind it. And then we say, oh, that doesn't quite make sense. Let's do it differently. And we do it differently, it makes more sense. Even in my brief lifetime of being a neurointensivist, when I was a medical student, in subarachnoid management-- if any of you take care of aneurysmal subarachnoids, the standard of care was you put them in a deep, dark, dingy room. You don't touch them. You don't do needle checks. It used to be called subarachnoid precautions. You would dry them out.

Because the neurosurgeons did not want to touch. Because the brain's angry. And if they survived five days, then they would go to coil clipping at that time. And by this time, literally 3/4 of the people will do really, really bad. Now, no matter how you come, my job as a neurointensivist, and in cohort with my ED people, is basically to get their ABCs taken care of, make sure their heart and lung is functioning, get them to the OR ASAP for clipping or coiling. So once the aneurysm is protected, patient's safe. So that has dramatically changed.

In my fellowship in 2009, we used to give albumin and overload these patients with what we call as triple H therapy. The holy grail was load them with fluids if they go into spasm, because once they go into spasm, the blood flow gets compromised. It doesn't matter if their lungs get overloaded. We'll intubate them if we had to. We'll put them on albumin drips. Now we literally do the opposite. We very carefully do targeted euvoolemia with induced hypertension. And in addition of taking care of their vasospasm, we make sure their lungs don't get fluid overloaded. Because we know that really causes bad outcomes. So even in the brief 20 years that I have been in the medical field, I've seen a very dramatic change. And that's how our medicine progresses.

We talk in conferences like these. We shared experiences. And based on those, we try new things. And our science progresses like that. And every five years, we pretty much start doing different things, which is good and bad. So I myself consider my science as a way of life, and more of an art, rather than a true science. And what we've honestly done differently in the last 20 years-- the way I put it is that we had done a good job of early identification and treatment of what we call a secondary insult. What's happened has happened. I can't fix ICH.

But what comes next is what I'll try to find soon and then fix it. Anticipate, prevent, and treat secondary physiological insults-- simple things like taking care of DBTs, taking care of bed ulcers, taking care of hypoxia, or taking care of pneumonias. Better nursing care. And utilize my network of professionals that are invested in recovery. So I have speech therapists, who knew how to take of dysphagia in stroke patients. I have respiratory therapists, who understand what it means to extubate a patient who doesn't follow commands from aphasia. So that's what's really changed.

And at the end of the day, you obviously have to give yourself the benefit of doubt and your patients the benefit of the doubt in how you look at it, whether you look at glass half full or glass half empty. So I'm going to talk about a few cases that I personally took care of. And all these cases basically represent the five things that-- basically, there's no new science behind it. It's the perspective on how you take care of. Either there is early diagnosis involved, that led to a different outcome, or there was a timely intervention that was offered and done, or there was a calculated risk versus benefits discussion. And risks were assumed to be that we'll take this risk to try the outcome that we think will benefit the patient.

The periprocedural care was committed. We decided to continue taking care of these patients. Even that little thing can make a difference. And the post-intervention care, obviously, was provided in this-- what we call as a neurocritical care unit. And I have to give you a disclaimer that, again, just like I said in the beginning, these cases do not represent the day-to-day life of a neurointensivist. We hope they do. For every case that is a good outcome, we probably have tens and scores of other cases that don't have a clinical outcome that is as good as this for the same. So I'm basically giving you the glass half full picture. So take it with a grain of salt.

So this was basically a patient that I took care of in my residency. And this was one of the cases that inspired me to do what I do today. He was a middle aged gentleman with not really decent history of diabetes and hypertension for a few years-- very well controlled, goes to the doctor, compliant with medications-- nothing out of the ordinary that would make you say he wasn't making good choice in his life. And he had what sounds like a right MCS stroke. You see that right MCS sign. And on angiograms at that time, where endovascular therapy was very new, we found that his complete right MC was blocked-- so his whole right side of the brain was at risk-- and decided to reperfuse him.

This was about 4.5 hours since onset. And despite complete reperfusion, as you can see on the angiogram, he had pretty much a decent MCS stroke. The whole right side of the brain was infarcted on the MRI. And then he herniated and got intubated. At that time was offered hemicrany. Family wanted everything done. He had two kids. And his wife said that it's really important for him to see his grandkids before he passes away. And she understood that she might not be making a decision that was conducive to his quality of life. He would never want to be in a bed-ridden state, having people taking care of him. cleaning him. But she still wanted to honor his wishes of seeing a grandkid born before he passes away. And that was the rational behind us proceeding with a hemicrany and a neurosurgeon who was willing to do that.

And the patient went through his usual course-- was trached and bagged-- pneumonias, DVTs, a nursing home for a few months. But by the time he-- it was a right-sided stroke, so he not have aphasia. But he was very determined to continue making himself better, to the point that he was back to his home in about eight, nine months. And I took care of him as a first year. And in my residency, we do a continuity clinic. We follow the same patients over years, to make sure that we understand how patients do over years, and how to follow them.

And he had no medical problems. He worked. He worked out himself, out of the diabetes and hypertension. He was a very muscular guy by the time I graduated in fourth year. And I would keep seeing him every six months and say, you know, I have nothing more to offer you. Your diabetes hypertension is gone. Just live your life. Joined a desk job-- not the same as before, but he was making a living. The only reason he would keep continue coming to my clinic is that we had taken his driving license away, because of deficits. And that expired at some point. And DMV took that away.

He was hoping that-- and he would not go to attending's clinic. He would go to resident's clinic-- that hoping some unwary resident would just allow him to drive again. And the fun part was if you see him walking, you could see he had this dystonia, for the therapists here. You kind of see that he's walking like this. But he was a completely functional guy, and except for driving, was doing everything himself. And that passion of going back to driving, and taking that dependency on his wife away, was so passionate to him that he basically kept on insisting to be in the resident's clinic.

So he was one of my really good ones. And I use this case to teach people the challenges of my ICU. So at that particular time, in 2006, when I took care of this case, there was no trial. There were three ongoing trials-- Destiny, Hamlet, and Decimal-- that were testing the use of hemicrany in malignant MCS strokes, big strokes that herniate. And until that point in time, it was very hard to find a neurosurgeon to do a hemicrany in these patients. So there was no evidence-based medicine. There was pathophysiology. 3% was just used-- [INAUDIBLE] was the basis of treatment. And 23.4% was not even born yet for clinical use.

We had lots of pathophysiological knowledge. But all our pathophysiological knowledge was based on one case report. So this is a published case report from Germany that basically showed that if you do hemicrany in a patient with malignant MCS stroke, you actually restore their blood flow. So these two grafts, red and blue, are basically their blood flow and the brain oxygen content-- that once you do the hemicrany in these patients, you actually restore the brain blood flow and their content. So the pathophysiological knowledge was that if you do hemicrany in these patients on time, before they herniate, you actually keep the brain from dying. Because maybe the whole brain's not dead.

And in 2007, this Lancet paper came in, which basically pulled together all the three trials, Decimal, Destiny, and Hamlet. Most of them were aborted in the middle, because of the outcomes already reached. And basically said that cautious use of hemicrany should be thought about in these stroke patients. There were only 93 patients who were enrolled in hemicrany 48 hours into the stroke. And to give you a perception of what the results were, everybody's familiar with the concept of numbers needed to treat? How many patients do you need to treat to see a good effect for that therapy?

If you do CABG, coronary artery bypass surgery, in patients, you need to treat 25 patients with CABG to see one survival prevention of death. If you give aspirin, you have to give aspirin to 300 patients before you prevent one death. Statins and stroke-- you have to give statins to at least 200 patients, with history of heart disease or risk factors for heart disease, before you prevent one death. If you give statins or aspirin to patients with no history of cardiac disease or stroke, there is no evidence that it prevents death. So the numbers needed to treat is infinity. The numbers needed to treat for this trial was two. You need to do hemicrany on two patients to prevent a death. You need to do a hemicrany in three patients to prevent a bad outcome-- modified ranking scale of four or five.

2007-- even it's 2016, I happened to be in a group of neurosurgeons who are very rational invested in the care. But there are practices of neurosurgeons that refuse to consider hemicrany in part of stroke care. This is the kind of world we live in. Now that decision is not easy. The decision that oh, right MCS stroke, do a hemicrany because the trial said so, and numbers needed to treat is really low. There are lots of factors that go into it. Is it a left-sided stroke? Is it a right-sided stroke? Is the aphasia important for the patient? Is the patient rehab-able?

Although right-sided strokes don't have aphasia, they're usually more difficult to rehab, because they have this thing called neglect. They do not know they have a deficit. So neuroplasticity depends on your brain to recognize a deficit and do something about it. So they're actually more difficult to rehab than aphasia patients. There are aphasia patients that just the presence of expressive aphasia bothers them so much that it impairs their quality of life, although they can do everything themselves.

I had a 32-year-old soldier that had an AFib with RVR, and had a left-MCS stroke. And he was the most depressed guy. And all of his interventions, medically, were depression, because of expressive aphasia. He had three kids. And he just couldn't communicate with them. And that quality of life perception is very hard to get in the few hours that you're trying to make these decisions-- And very hard to communicate to doctors. How many of you had that kind of a discreet discussion with your family members, that if I was to have a stroke, this is what I want to do, or this is what I don't want to do?

People may have other strokes than just one stroke. Stroke may come to us already formed, in which case edema's already peaked. So too many factors go into consideration to that decision that really make it difficult for us to translate that trial into daily practice. And that's part of the reason why we can't really get as much buy in as we want to.

It all depends on your perception. Sometimes it's the family's perceptions that have a negative. And families don't have social support and network. You may have a 23-year-old guy, who just happened to have dissection playing basketball, had a right-MCS stroke, but not quite completed, has taken very good care of himself. But once he gets that stroke, he has no support system to undergo the six months of nursing care. Say he doesn't have insurance, has placement issues, there's no social support to help him recover that. Do you really want to hemiparesis that patient? So these are the kind of decisions that affect our care and our decision on a daily basis, that cannot be translated in trials, and make it very hard for us to get evidence-based medicine.

If we're interested, this is a very good article in neurocritical care. And if you email write, I'm happy to give you guys a copy of this. The article is titled "A Life Worth Living-- Seven Years After Craniotomy." So this gentleman is a-- if you notice, the last names on the three authors are the same. So the first doctor is a guy who's a cardiac anesthesiologist, who trained at Princeton and Columbia, had about 30 papers well cited, was the head of the cardio anesthesia lab at Penn, and basically decided to go into private practice.

Very usual, takes care of himself-- you would never expect him to have cardiovascular disease. This is his story of in 2001, he had what he claims a very rough bout of bronchitis, cough. And on that, had carotid dissection, and had left-MCS stroke with complete aphasia and right hemiparesis. His wife is a pediatrician. And he got the usual stroke care, got a hemiparesis. He was taken care of in Pittsburgh. And the next six months, he got every state-of-the-art therapy, trial enrollment there is for stroke care.

His wife did not put her-- basically made it her business to make sure he gets any treatment offered, to the point that he spent 49 therapies in University of Galveston, to get hyperbaric oxygen therapies, which have never been proven to get stroke. By the time of six months, he was becoming independent in ADLs. But it still took him all these years to gather the cognition, to gather the understanding, and gather the passion back to write his experience.

And his last two paragraphs-- which are a little lengthy, but I want to read them out to you-- basically sum up the biggest challenge of stroke care, any way you give a perspective to. So he says, "Following discharge, the can ex--" and he's talking about usual patients. And he does acknowledge that he got the kind of care that you cannot expect a routine person to get, because they had the resources. And insurance never paid for any of those treatments.

So, "Following discharge--" they means usual population who has strokes-- "can expect at most several months of sporadic outpatient therapy. Had I been solely reliant on my insurers, I would not speak, read, or walk, and would require constant assistance. I was lucky enough not to be in the predicament. Luck is relative, however. This is not the life I enjoyed prior to my stroke. Nor is it how I envisioned spending my 50s. However, it is still a life worth living. I only have it due to the aggressive interventions I received after my stroke and the therapy I continue to pursue."

And he talks about his daily routine and all that stuff. But really puts a perspective for me that when it comes to making these decisions on the fly, you can't just put a perspective of what you're going to do that patient and how that therapy's going to end up. You also have to figure out the journey that the patient will have to take to get some hope of a quality of life that is acceptable to them.

This is another case. Now just to change the tone, this case doesn't have any perceptual issues, but basically represent the challenges of what is a very common acute ischemic stroke. But these are one of the cases which I would say I, myself, had a very negative perception, based on my training, based on my education. And this case gave me to light something to feel very proud of.

So there was a 35 female who had apparently a prolonged salon appointment, and came back with neck pains, and was found to have a vertebra R2 dissection, and was being monitored on the floor. Her CT angio was negative. And she was being monitored on the floor and being anti-coagulated. And I was called, as a Neuro-ICU fellow. And I used to respond to codes and acute crises on the neurology floors. So I was basically called because this patient was becoming extremely hypertensive, to transfer her care to the ICU, so she can be started on an nicardapine drip, to control the blood pressure, because of the dissection.

And as I was examining her, she started becoming dysphonic. She started losing her eye movements, although she was very awake and alert. And as I'm examining her, more objectively, she basically lost all brain stem reflexes in front of my eyes. And every time I examine her, she loses one more reflex, to the point that we basically say, let's transport her. And as we are transporting her, she becomes apnic, and starts-- it takes about a few minutes for patients to lose their SATs. So my hope was just to get her down to the ICU, from the sixth floor to the second floor, and intubate her there.

Long story short, we intubated her, stabilized her-- no brain stem reflexes. Got a CT angio. And she had what seems like a basilar artery stroke. Her CT scan basically shows a very small dot in front of the brain stem. But you can see the angiogram, where the basilar artery is absent. So she had probably thrown a clot from that vertebral R2 dissection into the basilar. And that was happening in front of my eyes. Basilar strokes are usually bad, because they affect the brain stem. And many of these cases get misdiagnosed, because of the nonspecific presentations-- headache, dizziness. Our patient's basically found unresponsive, and could have 100 million causes behind it.

And this was around noontime. And patient went to IR. It was decided not to give TPA, because of dissection, and her already being on heparin. And the clot was completely taken out. And she came back at around 3:30. Her anesthesia was reversed. And our sign outs usually happen at 5:00. And about 6:30, once the sign out was done, I wanted to tuck in everybody before I go home. And I extubated her. And the one thing I pictureously remember about this case is, when I intubate people, especially when I know it's a stroke issue, I have a habit of talking to them.

And Neuro-ICU people do that a lot. We talk to our comatose patients as if they're alive. At some level, it's a spiritual thing. You don't know what the patients have when you're talking to them. And my personal philosophy is, I'm extremely spiritual. Who knows what the patients state of coma is, or what their state of understanding is. And people can be scared. So if they hear me, I'd rather say something nice to them.

So when she had this-- when I was intubated her, one of the providers in the group was very belligerent and basically was asking me to speed up so the patient can go to the IR. And I wanted to prepare the patient and give full sedation and anesthesia before I intubate her. And that was an argument happening on the patients bedside, and as I'm bagging the patient. So I explicitly instructed, in a very arrogant and angry tone, that I'm the one intubated the patient. I will not intubate the patient without Etomidate and Fentanyl. I'm going to bag her until you get that.

And I don't know if she can hear me. But that's what's going to happen. It was not a good conversation that sets good example. And I talked to her, and I said-- I said her name. And I said, I'm going to intubate you. I'm going to put you to sleep. And if I put you to sleep right, you won't feel the blade. But if you feel the blade, it will be a steel blade. Don't be scared. It's going to be a tube in you. When you wake up, it's going to be a tube in your throat. So I pictureously described it, and was made fun of, which most neurointensivists do.

And once I extubated at 6:30, I basically asked her. I said, my name is Aarti. Do you remember me? And her first response after being extubated, after the day scenario, was, yes. You were the one who were saying, I don't know if she can hear me. I'm not going to intubate her until you give me sedation. And that redemption of-- and that is very precious in our life. That doesn't happen. I never wish this upon anybody. But I wish that would happen in more of my patients. So that redemption was something, was so precious, that this gift keeps coming in my memory, every time I have that experience again.

So very good outcome. Everything that could have been done was right in this patient. She got early diagnosis. She was seen by neurologists, neurointensivists. She was in the right place. She got IR therapy. She got extubated, did very well, and went back to life as nothing happened. It doesn't really happen often enough in our patients. And you would think that we've done a great job.

From CT scans, we've now come to MRIs. There are seven test lines. We can literally tease out every single nerve fiber. We've got comprehensive stroke centers. We are having strokes symposiums and educating people. We have subspecialized tracks to train these people. But even as of 2014, the paper itself has lots of flaws from the perspective of being written up as an article. But basically what it did was it looked at the health care costs and utilization in patient databases from nine states, and the state ED databases.

And every day, they will look back at the last 30 days of patients who were evaluated for some kind of-- every ED admission was evaluated. If you ended up in stroke, in the next 30 days, within those nine states, you were basically put in the database. So what they were looking for is how many times are we missing strokes? And they looked at all strokes-- hemorrhagic strokes, ischemic strokes. And they found 23,000 potential strokes, 2,200 probable missed strokes. That represents about 12% or 1% of stroke admissions respectively. 23,000 is not a small number in nine states.

And most of these patients disproportionately present with headache and dizziness, something that's a very common ED complaint. If you're an EMT, or a ER, or urgent care person, when practically every second person has headache and dizziness. How do you decide that? So that's the fallacy of our science, that even the simple things, like diagnosis of strokes and stuff, is not as streamlined and as prevalent as we would like it to be.

If you guys are interested, we all take ACLS courses, ATLS courses, PALS courses. The Neurocritical Care Society came up with emergency neurological life support, which is the ACLS of brain. And my hope is that in the next year or two, make it available to any provider who wants to take it at Wake Forest Baptist. But basically what it does is it goes back to simple basics-- again, no evidence-based trials behind it-- but basic science and pathophysiology of what to do when a patient comes with an acute neurological emergencies in the first 60 minutes.

So it literally gives you a small checklist to look at if you're an EMT, if you're an ED person, if you're a nurse, or if you're in medical search floor and you just happen to have a new acute neurological issue. And most of these are available online. I'm pretty sure they're on a paid access now. So it talks about, in stroke care, what to look at if it's a TIA. So it literally helps you walk through what needs to happen in those 60 minutes.

So that's the stroke side. How about the bleeding side? I talked about the ICH trial, that there were three big trials that were reported in mid-2000s. And one startling thing that came out of those trials, although these were the largest trials ever put together-- two of them were stick trials, if you remember. And 70% of these patients died from withdrawal of care. And that was a very startling discovery. So I'll give you two other examples of patients that basically represent two different sides of, again, the perioperative stroke care, or the spectrum of the continuum of care, where we failed the patient.

So this guy was a 70-year-old gentleman with history of diabetes, hypertension-- regular middle class American person-- decently controlled diabetes, hypertension. And he had what looks like a cerebralar bleed, with brain stem compression, and hydrocephalus, with intraventricular hemorrhage. It's a pretty bad thing to have. If you really look at literature, and if you calculate the scores, this patient pretty much has 90% mortality, based on what you see.

So this patient was seen at one hospital. Basically had no brain stem reflex at that time. And was told that the patient's brain dead, without a formal, thorough evaluation. A neurosurgeon was called, who looked at the scan. And it was a small hospital that only had one neurosurgeon, who only comes in when needed. And the neurosurgeon refused to come. And basically said, just tell the patient to let him go. So the family decided not to accept that predicament and said, we're going to take him to the next hospital.

So they went to Akron General Hospital, from that small ER. Akron is a smaller sub-- if you're familiar with the Cleveland area-- a smaller hospital. Not as big as Cleveland Clinic, but pretty decent. So he was transferred-- all the logistics that take place in transferring this patient. He was evaluated by a neurosurgeon who basically said, there are no brain stem reflexes present. And let's talk to the family withdraw care. And the family was belligerent and literally became offensive and basically said, no, you guys have no idea what you're talking about. Security guard and moral ethics got involved.

And basically, the end story was, after a couple of hours in that ED, they requested transfer to Cleveland Clinic. So patient was accepted directly from Cleveland Clinic-- so Cleveland Clinic doesn't have a nice-- it is a very good ER. There are literally eight beds there, if you've ever seen. Because most of the patients there come from other hospitals as a tertiary referral. So we, in the ICU, get to see a lot of patients that are directly dropped by EMTs, which is very precious. Because you get to take care of them in those first few hours that really matter.

So he was accepted by a neurosurgeon, who admitted the patient directly to the ICU and let us know that this patient is coming. And the exact sign out we were given is that he's probably brain dead. But my fellow neurosurgery colleague, who is in Akron, ended up in a very Scooby situation. And the family is pretty adamant that they want something done. So why don't you evaluate the patient. If he's not brain dead, give me a call. So we evaluated the patient. And the only thing he was doing is breathing above the vent. There were no other brain stem reflexes present.

He had a very-- and this is almost 18 hours into this whole fiasco happening, with a third visit, to a third different hospital facility. Multiple hours of discussions. Did not even repeat a CT scan. That's the one thing that I regret from the study. This was the only CT scan that we had. And long story short, the family convinced us that we want to give it a shot before we give it all. And we said, OK. Because that's what you do. How do you refuse somebody at the third go?

We let them know this is going to be bad case. We painted the journey ahead. We gave them no promises. And we extubated the-- patient got a suboccipital craning. Had a rocky course-- usual pneumonia, DVTs, PEs. But two and 1/2 weeks later, got extubated successfully. Had significant dysphagia. Absolutely no neurological deficits. Had a peg tube. And he went back to life as normal three and 1/2 months later. 70-Year-old guy-- diabetes, hypertension. So something I would like to see often enough. But I think that gives me an understanding how that dead plant example that I gave you plays so much a role in our part. Family took good care of him. Family was adamant, and basically were the champions, where even doctors failed.

On the other hand, this was a case I literally took care of this summer. And I pictureously remember this guy as the opposite side-- where no family. He was a 50-something male. And doesn't take good care of himself. Basically, he was found down on the street by the cops, unresponsive, unknown duration of time, cocaine in his system, extremely bad hypertension, and had pretty much the same pathology, and actually maybe a little worse, if not better. Bad cerebral hemorrhage, no brain stem reflexes, blown pupils, and was brought by the EMT, intubated.

And we checked [INAUDIBLE]. Paralysis has been reversed. And the guy had no brainstem reflexes. And we all looked at it. We thought we should give it a try, give him some mannitol, give him some 3%. Didn't really respond. So we basically-- the family said, that's fine. Let him pass. And he started twitching his feet about two hours into the whole-- so we were going to admit him to the ICU to declare him brain dead eventually. But he started twitching his leg a little bit.

So we said, he's twitching his leg. Let's see what happens next. So we gave him some more 23.4%, gave him some more manathol. And then we got two brainstem reflexes back. We got corneals back and we got gag back. So this is about six hours into the whole course, where he's been transferred to the ICU. Nurses have done their sign out and flow sheet, and families have been talked to. And six hours into this-- it's a Saturday afternoon-- the neurosurgeon and I, basically by bedside, said, you know, what's there to lose? Let's talk to the family. Let's give it a try. We gave it a try. First, we tried EVD-- didn't work. Clotted from all the blood. And then by 7:00 PM, he got a suboccipitalcrany and didn't look any different. And Sunday night, he became [INAUDIBLE] 15, and self-extubated himself Monday.

That's the good part. The bad part is where the journey starts, where the journey's important. Had no social support. Had no insurance. Could not get Medicaid, for some reasons. We could not place him. Oak Forest was the only place he could be placed. And he basically stayed in a hospital until September, because of lack of placement. And the only symptom he had was ataxia and vehement, arrogant noncompliance with medical providers. So he would refuse to stay in bed. He would keep on falling, and unfortunately, died of a fall in a hospital. He fell multiple times, developed AFib with RV, had anti-coagulation, but eventually died of a head bleed, as a result of a fall, in September. So the spectrum of what we deal with.

This was another case in my fellowship that was another social fiasco-- homeless guy, COPD. The ribs hug the pelvis, if you know the [INAUDIBLE]. And barely oxygenating-- 85%. Nobody to take care of him. He's [INAUDIBLE] intubated. And Ohio has this law that two attendings have to sign a paper saying, this is futile care. But it has to go through its legal process. So that process had been initiated for this patient, after all other options of trying to get therapy for this patient had gone away.

Decent CT scan. Pretty bad intraventricular hemorrhage with casted ventricles, which is a bad thing. And three weeks into his stay, we can't trach and bag him, because that requires a legal guardian to be appointed-- all those logistics. So he's basically sitting there. And it was Christmas weekend, or Christmas holiday season, of 2010. And I was this bright, smarty pants fellow. And I had a new attending, Dr. Downy, I remember.

So we basically had nothing to do that weekend. It was Christmas. We were stuck on Christmas. We did our usual-- nurses always bring food for us-- and had our Christmas celebrations, and have nothing to do. And we said, what would it take to wake up this guy? And so we literally did a science presentation. And said, OK, is it edema? We did a CT scan. And we actually did stuff to him. So we ruled out one thing at a time.

And in the end, we're basically left with vasospasm. It doesn't make sense for a patient with hypertensive bleed to have vasospasm. But we said, what the heck? We were literally bored. I'm going to admit that. And so we did a CT angio on him. He had horrible vasospasm. I was the last generation that did 36-hour calls. So 3:00 in the morning, we call the interventional people. And the interventional fellow comes down, with big French words, and said, seriously? That homeless guy that doesn't have like-- I will have to call the courts to get a consent, and all that stuff. So long story short, 7:00 in the morning, this guy went for angiogram, got angioplasty and intraocular verapamil. Comes out. Nothing happens, right? We got really ridiculed on Monday that these guys had nothing to do, and you are just making a deal out of this. But we said, so what?

Tuesday morning, I come back. And the guy self-extubates himself. [INAUDIBLE] of 15. And now I can't keep his SATs up, because he's such a bad COPD. So we treated him for COPD exacerbation. We discharged him home, because we couldn't place him two weeks later. Absolutely intact to go back to his life. So illuminating cases-- I wish I had more of them. And ENLS also addresses these. So basically, there are 14 pathways that ELS addresses. And even NICH talks about a lot of things that you can do in the first 60 minutes. And lots of other cases-- again, I can go on and on. There are not many. But there are just enough that I think it makes meaningful for me to talk about these cases.

But at the end of the day, if there's one thing that I would like for you to take out of spending your precious time with me, and listening to my rants, and my braggings, is one, there's a huge difference in perspective towards brain injury patients, stroke patients, compared to other diseases. You have to recognize that. If you don't know your implicit biases, you won't know you're biased. So if you look at this picture, you can-- I don't know if anybody knows this phenomena. You can either see a haggard old lady or you can see this awesome French knight. It depends on how you see it.

And not just seeing it-- it also depends on what you do about it. In our world, it becomes a very common academic discussion that whether you are anesthesia-trained ICU doc, versus neurology-trained ICU doc, who's better? At the end of the day, does it matter who's better? And it ends up what your perspective is and what you decide to do with it. So the only thing our science does it differently is, what would you attempt to do if you knew you could not fail? And present that therapy to the patient's family. Make a shared decision making model. And assess what the patient would want to do. And in your best judgment, try to do that, and honor the wishes.

And as health care professionals, we have to be very careful in making sure that our own biases don't get translated in those discussions with those. So the whole concept of informed consent means that you have to give a neutral assessment of risks and benefits. And for that, if you are familiar with this book, as my last slide-- so Sanjay Gupta. Everybody knows the guy, right? Awesome guy. I did not give Dr. Oz's example, for a whole different reason.

So he wrote this book called *Cheating Death*, which basically he's a neurosurgeon by training. And he talks about all these cases, similar to what I talked about. And he talks about how awesome these cases are, and how these cases cheated death. The problem with this book is, despite him being a neurosurgeon, he probably had it ghost written by somebody. And somebody advised him to write it in non-neurosurgical terms. But there are lots of factual mistakes in these terms that propagate misconceptions about brain death, about brain injury, and saying EG's flat, that really make people misconceived what lying ahead about the quality of life questions.

So be conscious of that when you portray that. And at the end of the day, I personally still think, like I started, that neurocritical care is not as much of as a science as a way of life. And so is your perspective. Whichever continuum of stroke care that you rely on, all these things apply to you, not just ICU. And you may not have the science to back it up, but it's the choices you make, for yourself and your patients, that impact the care. And as much as evidence-based medicine is the way to go, but when you have to make a decision, make sure you make the decision for that patient. Because having a wife, son, or brother is usually zero to one issue. It's not a 60% chance of survival, a 20% chance of death issue.

That's it.

[APPLAUSE]