

## Big Decision, Little Time

### When you're having a stroke, every minute counts

It was half an hour into the second shift at the steel mill when David's coworkers began to worry. A shift supervisor and former Marine, David lived by the rule that if you don't arrive fifteen minutes early, you're late. It concerned his friends even more that he hadn't called to let them know where he was. A quick call to his wife confirmed that everything had seemed fine when she'd waved goodbye to him in the driveway just an hour earlier. Two of his friends walked out to the parking lot, exhaling with relief when they spotted David's faded blue truck and David himself, sitting behind the wheel. But as they approached, they saw that something was wrong. He sat motionless in the truck, broiling in the late afternoon sun, beads of sweat tracking down his cheeks. He did not appear to hear or recognize them as they called out to him, turning his head to watch them knock on his window but making no move to open the door.

When EMS arrived, they checked David's temperature and measured his blood sugar and found neither to be abnormal. But as they coaxed him out of the truck and onto their stretcher, they discovered that his right arm and leg dragged behind him. They radioed the hospital to alert the staff: David, along with 795,000 other Americans this year, was having a stroke.

Stroke kills someone in this country every four minutes. This year, the numbers may be even higher. [The New England Journal of Medicine](#) reported this month that during the two-week period from 3/26 to 4/8, stroke evaluations dropped 38% across the country as people avoided seeking care in an emergency department, fearing exposure to covid-19. And there are growing numbers of case reports of stroke in young patients who have tested positive for the SARS-CoV-2 virus.

A stroke happens when blood cannot deliver oxygen to the cells of the brain, leading to irreversible cell death. This can happen in the setting of an aneurysm or high blood pressure, when blood vessels break open or leak, but most of the time the culprit is a blood clot in an artery that blocks the forward flow of blood. Patients suddenly develop symptoms that correspond to the area of brain that is cut off from oxygen and no longer working as it should: weakness on one side of the body, loss of sensation, cuts in the field of vision, inability to choose the correct words or to understand the words spoken to them.

For those who make it to the hospital in time, a drug called recombinant tissue plasminogen activator, or tPA, can improve or even reverse these symptoms by splitting apart the links that bind together the fibrous strands of the blood clot. Since its approval for use in 1996, tPA has transformed the care of stroke patients—at least for those who arrive at the hospital in time for it to work. tPA works best when given within the first three hours of the onset of symptoms. Beyond the 4.5-hour mark, it's usually too late. However, tPA carries with it a risk of major bleeding; in fact, one in every 17 patients who are treated with tPA will develop brain bleeding severe enough to worsen their neurologic symptoms, and nearly half of those who bleed into their brains will die. There is no approved reversal agent for tPA.

Even within the three-hour window of opportunity, every minute matters. [The Get With The Guidelines Registry](#) data collected from a large network of hospitals across the country show that the sooner tPA is given after symptoms begin, the better patients recover. Every minute a stroke starves brain cells of oxygen, 1.9 million more neurons die. And with that cell death, the risk of bleeding increases, with or without tPA. Dr. Saher Choudhary practices neurology in South Carolina, deep in the [stroke belt](#), where stroke mortality is disproportionately higher than that of the rest of the country. She describes it like this:

“When you sprain your ankle, you get swelling. Similarly, in stroke you get swelling in the brain as cells die. And just like your ankle turns black and blue when small blood vessels called capillaries burst and cause a little bit of bleeding, your brain does this, too. tPA will prevent the body from being able to clot and stop bleeding from those small capillary blood vessels. When you have a lot of swelling in the brain, you can have a bleed in the brain even without tPA. But tPA certainly makes it worse.”

So, in 2010, the American Heart Association/American Stroke Association (AHA/ASA) launched an initiative called *Target: Stroke* that places enormous pressure on hospitals to track and shorten their door-to-needle times—that is the elapsed time from when a patient rolls through the emergency department doors to the time the nurse pushes the drug into her vein. Physicians and patients must quickly decide if the anticipated benefits of pushing tPA outweigh the risk of bleeding, and they are often asked to do it with incomplete information while the patient is lying on the table in the CT scanner. Many patients who are having a stroke have lost the ability to speak or to understand words, some do not speak the same language as the physician, and none have family members present in the radiology imaging suite to help make this difficult choice.

To further complicate the decision to treat, there is no quick test that rules in a stroke. In the early hours of stroke, when tPA can be given, the CT images of the brain can appear normal. Changes that can be seen on the images can lag hours behind the onset of symptoms as brain cell death slowly leads to swelling and sometimes bleeding. The goal of the initial CT scan is to rule out the presence of bleeding, the first major hurdle to eligibility for tPA. Emergency physicians and neurologists make the diagnosis of stroke based on symptoms and physical exam findings and calculate severity based on a standardized tool called the [NIH Stroke Scale](#). This diagnosis is made even more challenging by conditions that mimic stroke, such as seizures, migraine headaches, or medication effects. “In that limited time when you’re trying to figure out what’s going on,” Dr. Choudhary says, “you may not always know immediately with a hundred percent certainty whether somebody’s having a true stroke or not.”

This year, *Target: Stroke* launched its phase III goals, which include shortening the tPA door-to-needle time from 45 to 30 minutes. To meet these time targets, stroke centers have assembled multidisciplinary rapid-response teams. Members of the team work to expedite each step in the care of these patients to shave off precious minutes of door-to-needle time.

The call from the paramedics on scene with David triggered a page to the emergency physician and nurse, the neurologist, a pharmacist carrying the \$9,000 dose of alteplase (tPA), and the CT

technician, who quickly cleared and held open a scanner. A stroke alert also typically notifies a hospital chaplain, to help contact and support the family, and an interpreter, when needed. For patients who drive to smaller, community hospital emergency departments without the resources of a comprehensive stroke center, neurologists are summoned virtually to the bedside through a telestroke robot and can interview and examine patients through the eyes of the camera and the hands of the emergency physician.

The stroke team assembled and met David as he rounded the corner into the critical care area of the emergency department, sitting upright on a bright, yellow EMS stretcher. The team engulfed David and the medics, and the crowd swept down the hallway to the radiology suite. “David, I’m Dr. Choudhary. Can you smile for me? Smile? Show me your teeth?” she asked, demonstrating what she wanted him to do while walking at a brisk pace beside the stretcher. David looked over at her but did not move his face. She raised his arms. “Hold them up, David. Hold them!” His right arm dropped to his side. She showed him her watch. “What’s this called, David? What do you call this?” He stared intently at the watch but said nothing as the stretcher locked into place beside the CT table. The team slid David onto the table and retreated to the control room to wait for the images. Dr. Choudhary scrolled through David’s electronic medical record, looking for anything that might disqualify him from treatment with tPA. Within seconds, cross-sectional images of brain flashed sequentially on the monitor. There was no sign of bleeding, making a blood clot the probable cause of his symptoms. Dr. Choudhary dialed David’s wife while the pharmacist cracked open the vial of tPA and mixed powder with water to prepare the weight-based dose. David, still strapped to the table, slid back into the doughnut-shaped scanner to capture the second set of images that zero in on the blood vessels in the head and neck, in search of the troublesome blood clot.

In the rush to complete the initial evaluation of a patient and determine eligibility for tPA, there is limited time to carefully review with the patient the risks and benefits of this drug. As with David, the patient is usually lying on a CT table staring upward into a sea of faces while trying to grasp the sudden transformation of a normal day into one of the most frightening days of his life. It is this facet of the push to reach time targets that gives some emergency physicians heartburn. The American College of Emergency Physicians (ACEP) has sparred with the AHA/ASA over the importance of taking a few extra minutes to ensure physicians can engage in meaningful shared decision making with patients before initiating a therapy that could lead to brain hemorrhage and death. Time is brain, but physicians are ever mindful of their oath: *primum non nocere*.

“Getting consent is a little tricky,” Dr. Choudhary says. “We always want to talk to our patients and let them know what’s going on, explain what tPA is and why we think it would be helpful to them. Unfortunately, sometimes we are in a situation where patients cannot tell us because they’ve had a stroke that’s affecting their speech centers, or they’ve had a stroke that’s so severe that their ability to make decisions is affected, and sometimes we just can’t reach family in time.” She continues, “It’s really important to save as many brain cells as possible. It can make a huge impact on how well people recover and if they can go back to their pre-stroke lifestyle—their ability to do their day-to-day activities, even go back to work.”

It is for this reason that neurologists will often treat with tPA based on an emergency exception to informed consent, believing that a reasonable person would not want to be denied tPA because she did not have the capacity to give consent. Traditionally, this exception to informed consent has been reserved for interventions that are meant to prolong life, such as CPR, but many physicians feel that since stroke is the leading cause of permanent disability in this country and the fifth leading cause of death, tPA meets this requirement. But the question remains: how many minutes should physicians take to attempt to secure informed consent from a surrogate before initiating treatment based on the emergency exception?

Dr. Robert Sade is a pediatric cardiothoracic surgeon who currently serves as the director of the Institute of Human Values in Health Care at the Medical University of South Carolina and is an expert on informed consent. “The number of neurons lost [per minute] is impressive but is relatively small compared with the total number of neurons—86 billion; nevertheless, exactly *which* neurons are lost is critical. Obviously, the usual process of informed consent and shared decision making require some modification under the circumstances of acute stroke. However, shared decision making is not impossible and should be carried out to the extent possible under the circumstances.”

The way around this sticky situation is to encourage people to talk with their families now, *before* they get sick, about the kinds of treatment they would and would not want. “Every chance I get,” Dr. Sade says, “I advise people to complete an advance directive, specifically, a durable power of attorney for health care.” Advance directives are legal documents that allow people to declare their wishes for their medical care before they become too sick to speak for themselves. The two most common of types are the living will, a written document that specifies treatment options for a narrow range of conditions at the end of life, and a durable power of attorney for health care, which designates a specific person to make medical decisions on a person’s behalf. Other forms of advance directives include allow natural death (or DNR) orders, organ and tissue donation forms, and the [POLST form](#), which is a set of orders signed by a physician ahead of time for use in emergency situations. The American Bar Association website provides [links to advance directive forms](#) recognized by each state.

Dr. Sade prefers the durable power of attorney for health care. “I always advise against filling out a living will because they are too restrictive and otherwise flawed.” The scope of a living will is so narrow that it often fails to give clear answers to medical treatment questions that arise. It is a poor substitute for a person who can be empowered to make medical decisions in a variety of situations based on knowledge of a person’s wishes and values. Though it is difficult to think about and discuss end of life care, an easy place to start is with the [Five Wishes](#) questionnaire. But it’s important to expand the conversation to include decisions that do not necessarily occur at the end of life—such as the decision to give tPA.

Dr. Choudhary reached David’s wife on her cell phone as she was driving frantically to the hospital. “Hearing that 6% risk of bleed, 3% of which can be fatal, that’s scary. It’s a very scary situation.

Statistics really aren't reassuring sometimes. But another way of thinking about it is 94% of people are going to do ok with it; they're not going to have a significant bleed."

David's wife consented over the phone to tPA, and by the time he completed his scans, the initial bolus had begun its work breaking down the clot in his left middle cerebral artery. He spent the night in the intensive care unit where the nurses woke him every hour to repeat a neurologic exam, keeping close watch for any signs of bleeding, but there were none. By morning, he was able to wrap his wife in a hug using both arms.