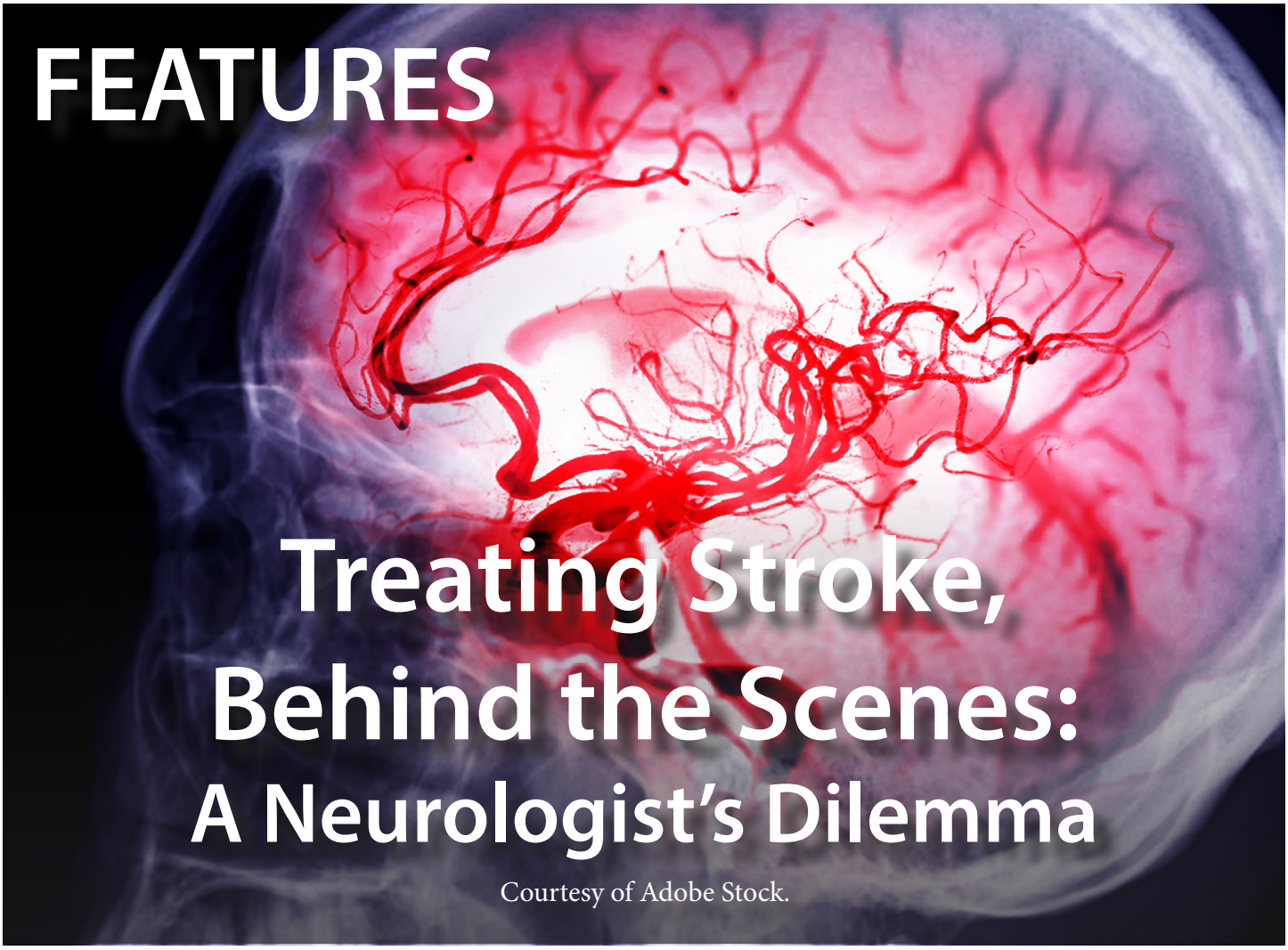

FEATURES

Treating Stroke, Behind the Scenes: A Neurologist's Dilemma

Courtesy of Adobe Stock.

Ambika Grover '27

(figures courtesy of Bridgette Pehrson '27)

Introduction

What is a disease without pain?

Many people have experienced a familiar headache after a long day at work, but those are easily relieved with a painkiller. Maybe they've felt a sudden wave of dizziness but brushed it off as dehydration or low iron levels. And what of the slurred speech episode of a dementia patient already struggling with communication? This, too, is easily dismissed as just another symptom. Why seek medical care just to incur a hefty bill?

"What is a disease without pain?"

These seemingly harmless "nuisances" can, in fact, be symptoms of stroke, a life-endangering brain injury to the central nervous system attributable to a lack of blood flow or burst blood vessels. Each year, about 795,000 Americans will have a stroke (CDC, 2024), and every four minutes, someone will die because of it (AHA, 2024).

When we think of life-threatening conditions, an acute cardiac arrest often comes to mind—a sudden collapse marked by loss of consciousness, with symptoms so unmistakable that they are recognizable even by the untrained eye. This is why many states require CPR training in schools—to equip a new generation with the skills to save lives in those crucial minutes before paramedics arrive (AHA).

Meanwhile, the less obvious conditions escape notice and sufficient preparation. Stroke's common symptoms—facial drooping, dizziness, aphasia (difficulty speaking or understanding speech), blurred vision, headache, and loss of balance—are often brushed off as a momentary impediment that can be self-treated. Its unremarkable

Portrait of Dr. Leung. Image courtesy of Tufts Medicine.

nature renders it a complex case needing time in the limelight.

As Dr. Lester Y. Leung, M.D., M.Sc., a vascular neurologist and Harvard College '06 alumnus, illustrates, "Often, what happens is that people sit on their symptoms for a while. They try to see if they can self-treat or go to sleep." He continues to explain that, alternatively, some patients experience loss of function, rendering them unable to speak or to call for help. Dr. Leung—who directs the Comprehensive Stroke Center and Stroke and Young Adults Program at Tufts Medicine and serves as an Associate Professor at Tufts University School of Medicine—plays a critical role in identifying stroke patients, facilitating prompt treatment, and increasing community awareness. His contributions have been instrumental in advancing stroke care throughout the Boston area.

Unfortunately for healthcare professionals, the challenge of administering quality care often begins beyond the reach of hospitals and emergency care systems. "There is a narrow window where people can receive treatment, but there are a million reasons why people can't go [to the hospital]. There are a lot of sociodemographic factors: whether or not you have a doctor or an available adult, child, or coworker [as well as] whether or not your community and family have the knowledge [needed]. There is a financial disincentive if people don't know right off the bat that they are at risk,"

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Dr. Leung describes.

Indeed, the average emergency room (ER) visit in the US costs between $2,200 and $2,600 for uninsured individuals (American Family Care, n.d.). Previous poor experiences in the hospital can also discourage someone from considering the ER an option, particularly if a visit may be a false alarm. Combined, the information gap and access gap serve as a barrier to stroke care before the patient has even had a chance to see the doctor. The bottom line then becomes that stroke isn't always severe in how symptoms appear—there can be a gradual, slow onset that escapes notice. This can make receiving care difficult.

Into the Hospital

The question returns to time for patients who do make it to the hospital. The gold standard treatment for ischemic stroke—which comprises

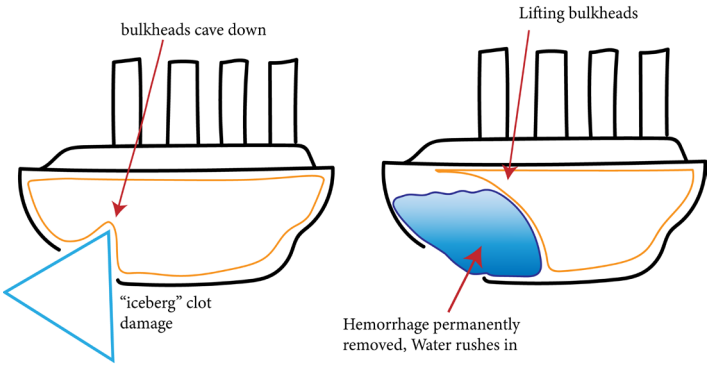

Figure 1. Illustration of the Titanic metaphor depicting how hemorrhage can occur in the surrounding tissue following the formation and removal of a clot.

approximately 85% of all cases and in which a blood clot restricts blood flow to the brain—has a three-hour limit under which it must be administered for patient safety (CDC, 2024). Blood typically flows from the heart, acting as a pump, and is then directed to supply different brain areas. Dr. Leung describes blood flow in the brain as analogous to a tree. "There are four large arteries, which are the trunk of the tree. [...] At the base of the brain, they branch out. Off [of] each branch, there are smaller branches," he explains. Blood clot blockages can also be understood using this analogy. If one of the largest "trunks" is blocked, it is called a large vessel occlusion (LVO). A blockage at the "branch" extending from the trunk can be referred to as a small or medium occlusion, which often cannot be detected in scans.

In many cases, a thrombolytic treatment—also known as a clot "buster"—is used to restore blood flow. According to FDA standards, the administration of the thrombolytic should be within 3 hours of stroke symptom onset (Hughes et al., 2023). The reality is up to individual doctors, hospitals, or field consensus; Tufts Medical Center, for example, authorized a 24-hour window for thrombolytic administration in light of delays caused by the COVID-19 pandemic.

However, restoring blood flow to the site of the brain injury may cause existing damage to worsen, possibly even leading to another type of stroke via a process known as "hemorrhagic transformation," or a brain bleed. In these cases, prognosis is exceedingly poor, with approximately half of patients dying within the subsequent 30 days. Dr. Leung describes why administering thrombolytic agents is time-sensitive: "It is like the Titanic, where the iceberg is tearing through different chambers in the hull of the ship. Bulkheads, the inner barriers within the hull, go down automatically when water rushes in. The idea is to prevent the whole ship from sinking. When part of the brain is sinking, the bulkheads shut down. But if we restore blood flow too soon, it can make things worse." Preemptively dislodging a blood clot—the "iceberg"—may have unintended consequences, explaining the complexity behind thrombolytic administration decisions.

At Tufts Medical Center, about half of the patients are brought in via ambulance, where paramedics can communicate with hospital staff to provide a preliminary assessment and indicate if the incident is likely to be a stroke. Dr. Leung describes this as the ideal scenario, giving hospital and neurology teams time to prepare and be in the bay when patients arrive. The end goal is to reduce the time to treatment and recognition to zero, "changing the process from serial to parallel." Other times, patients enter through the waiting room, where the description of symptoms to staff determines whether a red flag is raised.

The coordination of hospital efforts to get potential stroke patients seen as promptly as possible is another task that requires careful preparation and high-stakes decisions. Stroke does not necessarily manifest identically across people; different people can exhibit unique symptoms, making it hard to establish a uniform framework for diagnosis. For example, research has suggested symptoms can differ based on factors including sex and ethnicity (Hosman, et al). "I tell my trainees that there are 100 different symptoms, but there are 6–7 greatest hits. Those are the ones we teach to our physicians, but also what we teach our colleagues in non-neurology specialties," Dr. Leung explains.

Unlike diabetes or heart disease, stroke does not have a blood test to identify it. Instead, neurology teams must work to "triangulate" around the disease, leveraging tools at their disposal. For instance, Magnetic Resonance Imaging (MRI)—a type of diagnostic test that can create detailed images of internal parts of the body—is highly useful, but most hospitals cannot offer it within the first

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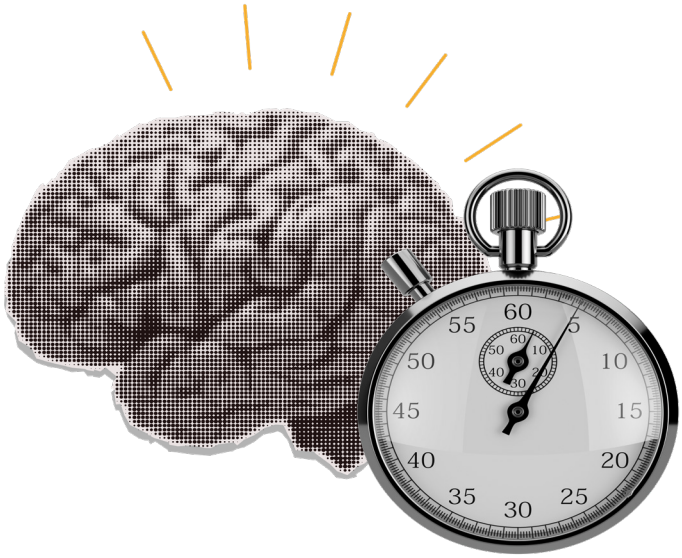
hour of a patient's arrival. Herein lies another challenge in administering quality care: hospitals are not created equal, and the resources largely determine what care patients can receive. A community hospital affiliated with a medical school likely has better facilities and more neurologists, resulting in a much larger reach than that of



a single, rural hospital. Once the patient is in the hands of emergency response teams, it is up to emergency care units to diagnose, assess, and treat the stroke as quickly as possible.

Gambling with Time

An elderly patient arrives at the emergency room, where they are promptly admitted and placed under the care of a team of neurologists due to a suspected stroke. But what is the time since the patient started exhibiting symptoms? Unknown—a caretaker arrived this morning to find them slurring their speech and unable to move the right side of their body. Neurologists suspect a medium-sized blockage but are worried that symptoms may have started the previous day. And, while administering a thrombolytic could restore blood flow, it could also lead to another bleed, particularly given the patient's age.

Determining the time since stroke, which is crucial for the administration of time-sensitive thrombolytic treatment, is often an unclear process. Neurology teams must ask family members to answer difficult questions about the onset of symptoms. If there was a delay in admitting the patient from the emergency room, that also must be considered. Unclear time windows are a recipe for tight calls, meaning that the choice to administer the double-edged treatment falls on the neurologist.

In ambiguous situations, giving a patient a thrombolytic at the end of the window can be risky. But risk aversion in and of itself has the potential to harm, too. Dr. Leung highlights doctors' conundrum: "There are certain principles or Hippocratic oath[s] you subscribe to. [...] We often uphold ["do no harm"] as a core principle, but people can go too far, do nothing, and not take risks. It's a false dichotomy because, if you choose not to treat something, you are potentially withholding treatment that could have significantly benefited the patient."

Given the choice, neurologists often closely consult the family about the benefits and drawbacks of treatment. For instance, administering a thrombolytic may expedite recovery but may also increase the risk of death if things do not go as planned; a doctor might take the time to explain the situation to a close family member, ensuring they understand the associated risks. Establishing a shared understanding reduces the likelihood of conflict.

Ultimately, the decision from there varies from neurologist to neurologist—rather than following strict guidelines, choosing to administer the drug comes down to risk thresholds. "Our brains are not always built to think scientifically when thinking about how to make decisions. Everyone is a little different," Dr. Leung remarks. Negative experiences, such as a lawsuit or an unsuccessful treatment can leave a lasting imprint on a neurologist, making them unwilling to take risks in the future, even if it could help the patient. Left unchallenged, such an experience can influence a neurologist's outlook forever. According to Dr. Leung, the way to correct that is "to anchor your experience with assessing patients at different time points, data, [and] probability while also connecting with patients on a personal level." Administering stroke treatment is a complex, high-stakes puzzle that demands careful precision, but with the right interventions, recovery from stroke is possible—physical therapy, speech therapy, and other programs can help survivors reclaim full independence over time.

"At the center of it all is a simple lesson: every second counts. When the time window is unclear, it falls on the neurologist and families to make swift decisions, aiming to set treatment in motion before it's too late."

At the center of it all is a simple lesson: every second counts. When the time window is unclear, it falls on the neurologist and families to make swift decisions, aiming to set treatment in motion before it's too late.

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