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HAIL TO THE CHIEF

He may have been a fictional president, but Jimmy Smits, MFA '82, is for real

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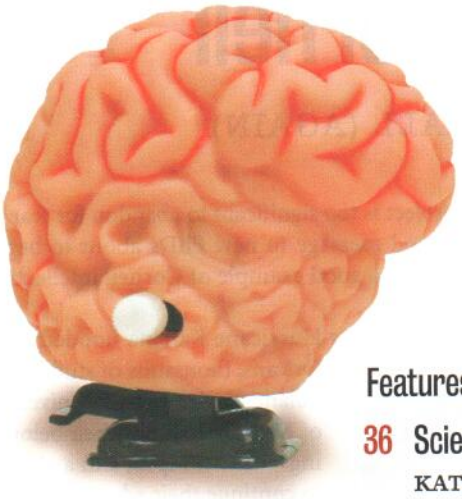

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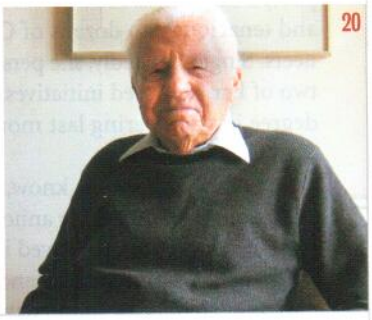

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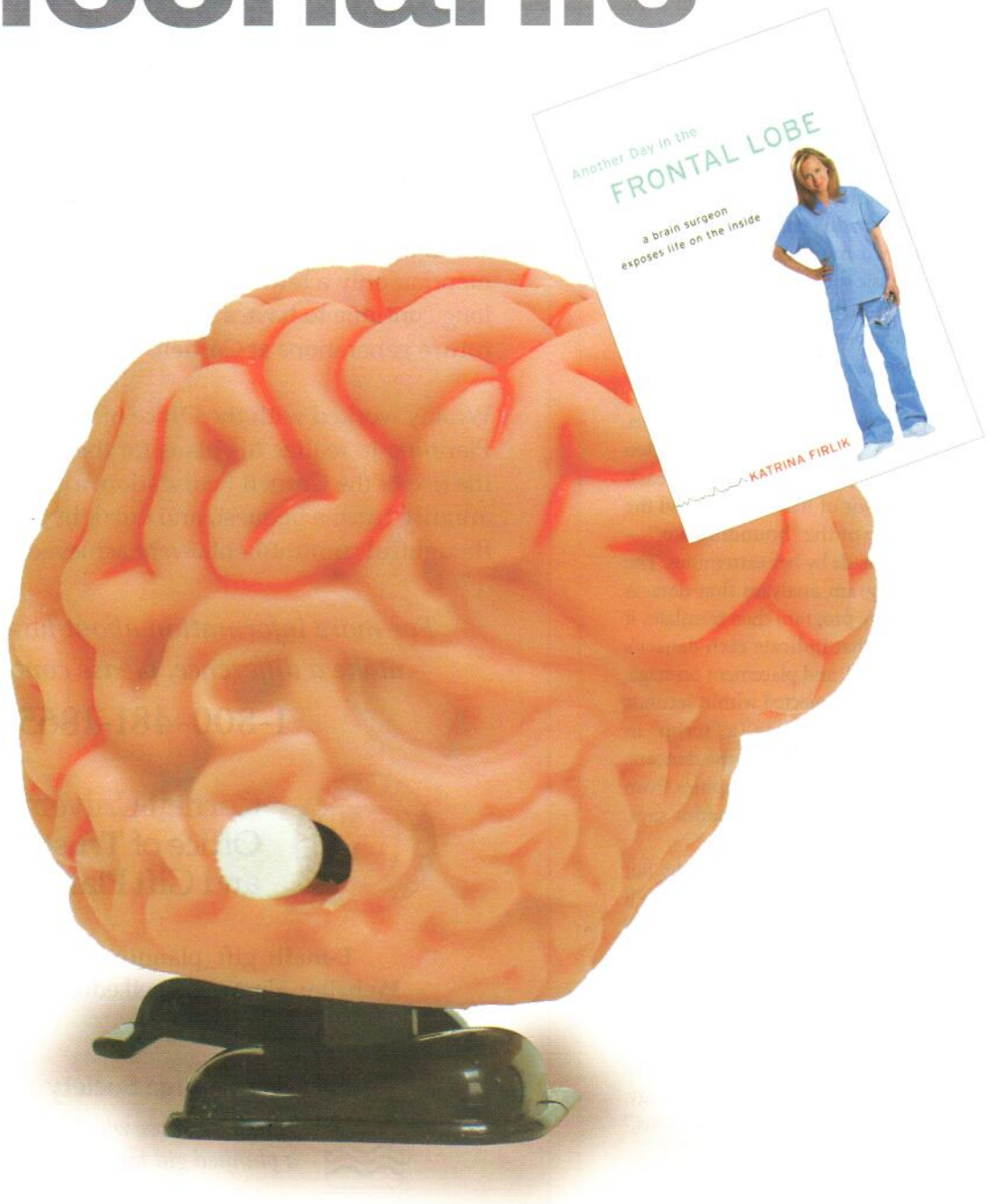
Scientist & Mechanic



Neurosurgeon Katrina Firlik '91 gets inside your head

When Katrina Schreiber Firlik '91 came to the Hill in 1987, she intended to major in cultural anthropology. "Even as a child, I was fascinated by the idea that there isn't one 'correct' way to live or to think about things," she says. "I sought out anything foreign and had pen pals from around the world. Cultural anthropology seemed to fit with that, because it examines the shared thinking that forms the basis for culture."

It wasn't long, though, before her interests began to veer in a more scientific direction. Part of that was because of her husband-to-be, Andrew Firlik '90, MD '93. "We met at Okenshields when I was a freshman," she says. "He wanted to get to know me, so he threw a piece of lettuce at me." Andrew was pre-med, and Katrina took an interest in some of the subjects he was studying—especially the brain. "That was a natural extension of my interest in cultural anthropology," she explains. "I could examine things one step deeper—the part of us that forms the basis for those shared thoughts."

After graduating, Katrina returned to her native Cleveland to attend medical school at Case Western Reserve University. She maintained a long-distance relationship with Andrew, who went to Cornell University Medical College, and the couple married in 1993, just before Katrina's third year of med school. After receiving her MD, she joined her husband as a neurosurgery resident at the University of Pittsburgh Medical Center, where she was the first woman admitted to the neurosurgery program.

During the seven rigorous years of training as a neurosurgeon, Katrina kept a journal. "I didn't necessarily have a book in mind," she says. "I just knew that I was seeing some incredible things, and I thought that I'd like to keep track of them. But once I finished my training, I realized, well, I can't waste these stories. I have to do something with them." What she did was write a book called *Another Day in the Frontal Lobe*, which was published in May.

Katrina says her interest in writing was spurred by a Cornell course called the Art of Essay, taught by the late Charles Levy, PhD '62. "He gave us free rein. He would say, 'OK, this is an essay where you have to convince somebody of something controversial' or 'Here's one where you have to describe how you do something difficult.' That was so much fun, it wasn't even work." She must have gotten an "A" from Professor Levy, because her writing is clear and graceful, and she has the ability to make even the most abstruse neurosurgical procedures both understandable and a bit less frightening.

Currently in private practice in Greenwich, Connecticut, Katrina also serves as a clinical assistant professor at the Yale University School of Medicine. Her husband, while still a practicing neurosurgeon, holds an MBA and works as a venture capitalist with a special interest in the development of medical devices. He is a partner at Foundation Medical Partners in Rowayton, Connecticut, and a member of the Life Sciences Advisory Board at Cornell.

Now expecting her first child, Katrina Firlik says she hopes to continue her writing career, perhaps by picking up where her first book left off. "The last chapter is about the future, so after I finished that, I was inspired to think about book number two, which would be a blend of fiction and non-fiction," she says. "What will the future look like in ten or twenty years? I have some ideas about cognitive enhancement—procedures performed on normal people who want to improve their memories and that sort of thing. It sounds futuristic, but I think the field is going in that direction."

— Jim Roberts '71

Excerpt from

Another Day in the Frontal Lobe

The brain is soft. Some of my colleagues compare it to toothpaste, but that's not quite right. It doesn't spread like toothpaste. It doesn't adhere to your fingers the way toothpaste does. Tofu—the soft variety, if you know tofu—may be a more accurate comparison. If you cut out a sizable cube of brain it retains its shape, more or less, although not quite as well as tofu. Damaged or swollen brain, on the other hand, is softer. Under pressure, it will readily express itself out of a hole in the skull made by a high-speed surgical drill. Perhaps the toothpaste analogy is more appropriate under these circumstances.

The issue of brain texture is on my mind all the time. Why? I am a neurosurgeon. The brain is my business. Although I acknowledge that the human brain is a refined, complex, and mysterious system, I often need to regard it as a soft object inhabiting the bony confines of a hard skull. Many of the brains I encounter have been pushed around by tumors, blood clots, infections, or strokes that have swollen out of control. Some have been invaded by bullets, nails, or even maggots. I see brains at their most vulnerable. However, whereas other brain specialists, like neurologists and psychiatrists, examine brain images and pontificate from outside of the cranium, neurosurgeons boast the additional manual relationship with our most complex of organs. We are part scientist, part mechanic.

The scientist in me revels in the ethereal manifestations of the brain: the mind, consciousness, memory, language. The mechanic in me is satisfied by the clear fluid that rushes out of the end of a tube I insert into a patient's brain to relieve excessive pressure. In everyday surgical practice, the science may take a backseat to the handiwork, and that's okay. If you have an expanding blood clot in your head, you want a skilled brain mechanic, and preferably a swift one. You don't care if your surgeon published a paper in *Science* or *Nature*.

I'll give you an example of a most straightforward and manual case. I was paged to the emergency room a few years ago during my training and received the following brief report over the phone: "carpenter coming in with a nail stuck in the left frontal region of his head . . . neurologically intact." What is going through my mind at this point? Do I hark back to my studies of frontal lobe circuitry and mull over the complex neural networks involved in language and memory? No. I'm thinking concrete, surgical thoughts: nails are sharp; the brain is full of blood vessels; the nail may have snagged a vessel on the way in. These thoughts are instantaneous, of course. I spell out the simple logic here purely for effect.

What I encountered in the ER was a young man, in his thirties, sitting up on an emergency room gurney. Perfectly awake and alert, arms crossed in repose and still in his construction boots, he smiled nervously when I walked in. Was he the right patient? He looked too good.

He was the right one. The carpenter explained that he and his friend were both on ladders along the side of a house. His friend was working a few rungs above. They were driving heavy-duty nails into the siding with automatic nail guns. His friend's hand slipped upon firing in one of the nails, and the nail entered the left frontal region of my patient's head below. For the first few moments after impact, the carpenter doubted what had happened.

Although he noticed a stinging sensation within a split second of his friend's slip of the hand, and heard the loud expletive coming from the same direction, there was no trickle of blood and he felt nothing unusual as his fingers frantically searched the top of his head. He wasn't sure if it went in. His friend knew otherwise.

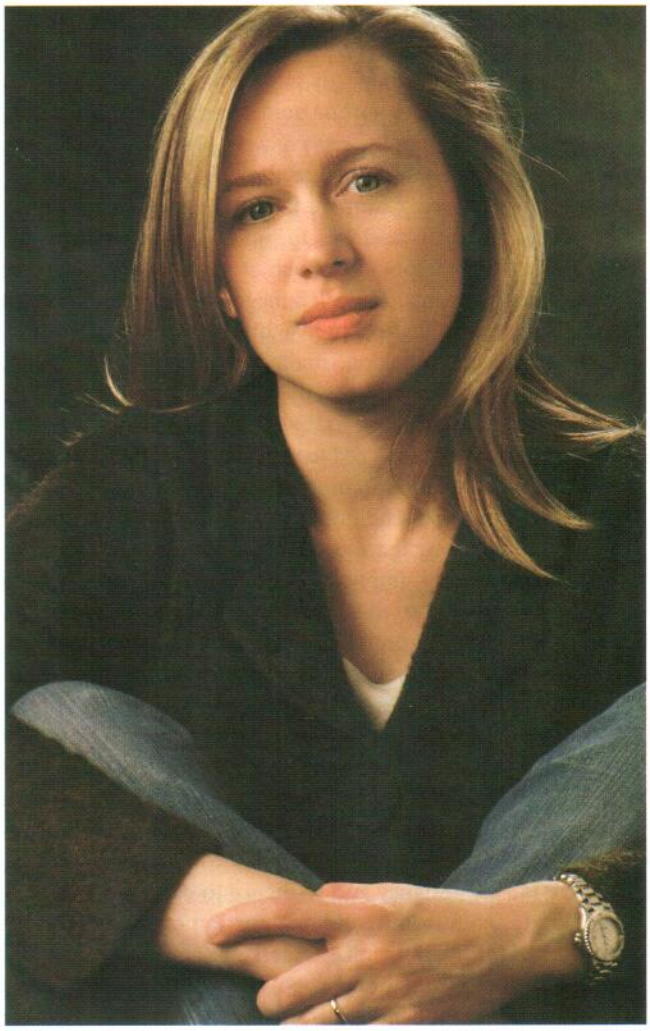
Upon close inspection of his scalp, past his short crew cut, I could see the flat silver head of the nail, not quite flush with the scalp, but a bit deeper. Apart from the nail, he looked great. I performed a quick five-minute neurological exam and found nothing wrong. I sent him down the hall for a CT scan. The nail entered his brain perfectly perpendicular to the surface of the skull. It had been driven a good two inches into his left frontal lobe. Luckily, it didn't snag any sizable blood vessels along the way. There was no evidence of bleeding within the brain. Unlike the more common gunshot wounds we see, this was a respectably neat and clean penetrating injury.

At this point, my biggest fear—bleeding in the brain from entry of the nail—had been put to rest. Now, do I take a breath and mull over any complex scientific issues at this point? Am I exercising my formidable brainpower as a brain surgeon? When people say, "it doesn't take a brain surgeon," they refer to the assumption that we are the smartest ones around. Have I demonstrated this superior intelligence so far? Again, my thoughts return to the practical and concrete. We need to get the nail out of this guy's head. It didn't cause any bleeding on the way in. We need to avoid bleeding on the way out.

I walked out to the waiting room. His wife was there and so was his friend, who was pale and despondent, looking down at the floor. I tried to cheer them up a bit. Yes, the nail entered his brain, but his brain function, as far as we could tell, was normal and the nail caused no bleeding. Without looking up, the friend opened his hand and offered me a large silver nail that had been warming in his palm, the same type embedded in my patient's head. "I don't know . . . it might help you guys to have one of these . . . so you know what you're dealing with." I hadn't been able to tell from the scan that the nail had two copper-colored barbs sticking out from the shaft at acute angles. I'm not a carpenter, but I figured that the purpose of the barbs was to ensure a strong hold. I thanked him and pocketed the nail in my white coat. On my way back to the ER, I ran my fingers over the pointy barbs and thought about the issue of bleeding again. Avoiding and controlling bleeding are elementary and pervasive themes in surgery—not quite the stuff of rocket science, but critical nonetheless.

After calling on the appropriate team, including the supervising neurosurgeon and anesthesiologist, I took him to the OR, shaved a small patch of hair around the nail head, and made a short linear incision in his scalp, down to the skull. There are no how-to entries in our textbooks regarding removing nails from heads, so we improvised using common sense. We drilled out a disc of frontal bone from his skull, with the nail head at the center of the disc. Slowly, we lifted this piece of bone up away from the surrounding skull, bringing the firmly embedded barbed nail with it. Although we could see a small jagged tear in the covering of the brain and a puncture wound on the surface of the brain itself, there was no blood oozing from the hole, and we considered ourselves lucky. ("Better lucky than good" is a favorite slogan among surgeons.)

Then, using large tools fit more for our patient's line of work, we clipped off the barbs and pounded the nail through the disc of skull, backward. After soaking the bone in an antibiotic solution, we neatly plated it back in place with miniature titanium plates and screws and sewed his scalp back together. Actually, rather than suture, we used surgical staples from a staple gun to close the final layer of his scalp, unaware, at the time, of the subtle irony in that move. Within less than twenty-four hours, the patient was on his way home, joking the entire length of the hall with the friend who nailed him in the head.



KIT KITTLE

Dr. Katrina Firlik '91

When I recounted this story to my family and friends after dinner one night, they all nagged me with the same question: "How could he be normal? This went into his *brain*." Finally, here's where the scientist in me gets to pontificate a bit, settling into a fast-paced question-answer session in the comfort of my own home with a captive audience. I am not just a mechanic, after all, and the brain is not just tofu.

How could he be normal? First of all, his brain function was considered normal based on our typical bedside examination, which is, admittedly, a bit coarse. His speech was fluent. He answered simple questions appropriately. I asked him to remember three objects over a five-minute time span, and he did. His pupils reacted when I flashed a light in his eyes and his eyes moved symmetrically. He had no drooping of his face. The strength in his arms and legs was normal and so was his sensa-

tion. His reflexes were fine. He was capable of rapid and coordinated hand movements. In other words, his five-minute neurological examination was perfectly satisfactory.

But the frontal lobes harbor quite sophisticated functions, more sophisticated than the relatively simple ones I tested. The frontal lobes make up the largest section of the brain and are the most recently evolved. Compare the forehead of an ape to the forehead of a human. One slopes, the other bulges. We can thank, or blame, our frontal lobes for much of what we consider to be our personality and intelligence. Damage to the frontal lobes can be subtle, including changes in insight, mood, and higher-level judgment ("executive function," in the professional lingo). I'm not going to detect such changes in the ER during my five-minute exam before he is whisked off to the CT scanner. I'm just the neurosurgeon here. We would need to consult a neuropsychologist to help us evaluate these more complex brain functions.

"So why didn't you send this poor guy for more sophisticated testing?" my dinner audience asks in a confused and mildly accusatory tone. Why did I simply proclaim him "fine" and send him on his way? I explain that the foreign object was a nail, not a jackhammer. A relatively minuscule portion of brain was violated. The large frontal lobes, in particular, can be quite forgiving, especially when only one side is involved. It's not unusual to see a frontal lobe tumor, for example, grow to impressive citrus fruit proportions before the patient even detects a problem. In fact, the patient often does not detect a problem at all. It is frequently a spouse or friend who insists on the doctor appointment, explaining: "He's just not right, but I don't know what it is."

There is a redundancy and resilience to certain brain functions. What is compromised in one portion can sometimes be compensated for in another. (A remarkable ability referred to as "plasticity.") Even if the brain doesn't compensate directly, the patient often can cope indirectly, without even realizing it. If a person develops minor difficulty with memory, for example, he may start to write more things down, thereby maintaining the otherwise seamless flow of his existence. There are limits, though, to the power of plasticity. Damage to a single frontal lobe is frequently well tolerated (the opposite frontal lobe can compensate to some degree), whereas damage to both sides is often irreversibly devastating.

"The large frontal lobes, in particular, can be quite forgiving, especially when only one side is involved. It's not unusual to see a frontal lobe tumor, for example, grow to impressive citrus fruit proportions before the patient even detects a problem."

Getting back to our carpenter, we were confident that the very narrow swath of injured brain in only one frontal lobe would be inconsequential. Even if a faint cognitive deficit could be identified with detailed and time-consuming neuropsychological testing, would the patient really care? Would he, or anyone else, even notice the problem? Would his life as carpenter, husband, or friend be affected? Doubtful. On a more cold-blooded and practical note, would the patient or the hospital be willing to pay for these tests? His insurance would certainly balk at the cost and question the necessity. Besides, given my confidence in the resilience of his frontal lobes, my biggest concern was not sluggish thought but sluggish carpentry. What if he gives up the automatic nail gun altogether?

And with this final thought, the mechanic in me reclaims the front seat, as the scientist heads again to the back.

It doesn't necessarily take a brain surgeon to think like a brain surgeon, especially when it comes to the fundamentals. Consider this elementary notion: there is a limited amount of room inside the skull. Another central truth, directly related to the first, is: the brain is not the only thing inside the skull. The brain, in fact, makes up about 80 percent of the intracranial contents. The other 20 percent is split about evenly in volume between blood and cerebrospinal fluid. Once you master these central tenets, a good deal of seemingly complex neurosurgical decision-making becomes transparent.

Neurosurgeons learn to care just as much about the 20 percent as they do about the 80 percent, even though everyone else is blinded by the mystique of that 80 percent. I get plenty of wide-eyed questions about the brain, but no one ever cares to ask about the cerebrospinal fluid, a real nonissue as far as the public is concerned. Neurosurgeons care about the cerebrospinal fluid because if there's too much of it, the brain could be rendered next to useless.

In learning to think like a neurosurgeon, you have to take these thoughts one step further: given the rigid, fixed-volume container of the skull, and the 80/10/10 balance of its contents, what can be done if the equation is disrupted? This tips us more into the realm of mechanic than scientist.

Consider what would happen if you were punched in the eye. The area around the eye becomes swollen and is free to swell as much as it needs to. Aside from the social and cosmetic downsides of having a puffy, swollen eyelid and face, the swelling itself is usually not dangerous. It's not constrained. It goes down after several days, and the skin and underlying soft tissues recover nicely.

A swollen brain is another matter. There's not much room for it to swell. Swelling within a fixed container leads to elevated pressure, and unchecked pressure can lead to a cascade of events—namely a last-ditch shifting of delicate intracranial contents—that can be fatal. So as neurosurgeons, we do whatever we can to maintain a normal pressure within the skull when things go awry, such as in a serious head injury.

Although this is "brain surgery," the options we have for treating high pressures within the head are relatively simplistic and mechanistic: drain off cerebrospinal fluid from within the skull, shrink the brain tissue itself with a temporary dehydrating agent, or constrict the blood vessels in the brain via hyperventilation (although this one can be dangerous in situations when the brain needs all the blood flow it can get). If these options fail, there are more extreme measures, as a last resort: remove a portion of relatively "unimportant" brain tissue to create more room, or remove a section of skull to allow the brain to continue to swell. The decision as to which of these extreme measures you choose is largely a matter of who your mentor was and what he or she preferred to do.

As an example, here is how I handled such a decision recently. It was a warm sunny Sunday afternoon and I was sitting at an outdoor table at an Italian restaurant with my husband. We were eating salad and waiting for our Margherita pizza, content in our idle people-watching and discussing what we wanted to do after lunch. Our contentment was interrupted by my pager. It was one of the medical interns at the hospital: "Dr. Firlik, we need you to see a patient in the ICU, soon as you can. He had a stroke a few days ago and now he's herniating."

"Herniating" refers to the end-stage shifting of the brain in response to increased pressure. The word puts everyone into crisis mode, including my husband who, overhearing my conversation, had our pizza boxed up so he could eat it while sitting in the passenger seat of my car as I sped down the highway. He is also a neurosurgeon but, because of his passion for innovation and entrepreneurship, pursued a career in venture capital. He has always been interested in challenging cases, so he still likes to offer his two cents when it comes to critical decision-making.

"So what are you going to do for this guy?" he baits me, between bites, his smile glistening.

"I don't know. I haven't seen him yet," I answer, stating the obvious, not interested in debating the pros and cons of surgical intervention as we have done on so many other occasions with each other and with colleagues, to the point where it feels that we are following a script.

"Well, just call me if you're going to the OR. I'll leave my cell on." He gives up and pulls a second slice out of the box while wondering out loud what he should do to amuse himself while I'm busy. He'll probably go to a café and read a couple newspapers, further broadening his understanding of the world we live in.

We arrive at the hospital and my husband assumes the driver's seat. I leave the car, enter the hospital through the automatic glass doors that seal shut behind me, walk down the hallway to the ICU, and prepare to immerse myself in a very small, intense, and isolated world.

I have three priorities: evaluate the scan, evaluate the patient, and then step back for a gestalt, big-picture view of everything. The patient's scan is a textbook example of a major stroke that has swollen aggressively. An "ischemic" stroke—due to blockage of blood flow to a portion of brain—causes part of the brain to die. (Just as a heart attack causes a portion of heart muscle to die.) Dead brain tissue swells. If a large portion of the brain has died, such as in a complete middle cerebral artery stroke, the swelling can be quite impressive, to the point where it causes the brain to shift within the skull, threatening the viability of the remaining normal brain and brain stem.

Where I trained as a resident, a "strokectomy" was advocated in certain life-threatening situations. In a strokectomy, a portion of dead brain tissue is surgically removed in order to leave more room for the remaining, unaffected brain. The concept is somewhat controversial and the practice is not widespread, but it truly can be a lifesaving procedure. The question, of course, is whether or not the life in question should be saved, given concerns of quality over longevity, and that's where the decision can get tricky.

I did a brief neurological exam on the patient while the family waited outside the room. He was clearly in dire straits. I ordered a stat dose of mannitol to be given through the IV to buy us some time. This would temporarily lower the intracranial pressure by dehydrating his brain a bit. The effects don't last long but it's perfect for such a situation. I would have a few minutes to talk to the family, the neurologist, and the internist in order to get the critical big-picture view, as this was my first time meeting the patient. What was he like? What would he want? What do we want?

A living will doesn't always give clear direction. I remember seeing one in a patient's chart that included a few lines at the end that the patient had added in his own words. It said, in large, almost childlike, handwriting: "I do not want no machine hooked to me. Soley to keep me alive." Unfortunately, I couldn't extract any further meaning from these words apart from what was already in the legal text, but the handwritten words were far more endearing.

Conversations like this require as much listening as talking, if not more listening than talking, and this is when the neurosurgeon is neither scientist nor mechanic. After holding court with all parties, the decision was clear: no surgery. The patient was elderly, and fragile in so many ways. His neurological deficits were significant, and his outlook was bleak, even with a technically successful emergency operation. Everyone agreed to no "heroic" measures (an odd term in a situation like this, as sucking out dead brain tissue in a frail elderly man seems more pathetic than heroic).

In the instant the decision was made, the intensity that had stricken that small world vanished. The nurses moved more slowly. The looks of panic, fear, and confusion on the family members' faces were replaced by a simple sadness. The neurologist and internist left the ICU to attend to other concerns. I lingered for a few moments in an attempt to soften the blow, as if I could somehow soften the blow.

In thinking like a neurosurgeon, not everything comes down to a mechanistic evaluation of the intracranial contents. You do have to know about everything that can go wrong, and then about everything you can do to fix it, but then you also have to know when to do nothing. Certain decisions come down to a judgment call based on the gut, and that's when both the scientist and the mechanic step aside.

I returned to the nurses' station and dialed my husband's cell phone. He answered and I heard music in the background. I could picture him in the café, sipping a latte and flipping through the *New York Times* "Week in Review" section.

"Can you come pick me up?" I asked him.

"Sure. No surgery? Let's enjoy the afternoon then," he said, matter-of-fact.

And I did enjoy the afternoon, strangely enough. Because, in thinking like a neurosurgeon, you also have to know how to make a decision in the face of tragedy and then just move on.