Evolution of Brain Surgery to Destroy Rogue Blood Vessels

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Jackie Carr

Over three decades, a world-recognized medical team at UC San Diego Medical Center has spurred the evolution of a complex surgery to destroy dangerous clusters of arteries and veins in the brain. Integrating innovative approaches in radiology, anesthesia, and surgery, the team has perfected a method to systematically starve these abnormal brain lesions, artery by artery, vein by vein.

"In the late 70s and early 80s, medical teams attempted to remove these lesions during a single surgery, frequently encountering catastrophic episodes of brain swelling," said John C. Drummond, MD, professor and anesthesiologist at UC San Diego Medical Center. "Today, with a combination of embolization, the use of a medical coma, and staging shorter surgeries, patients experience consistently good outcomes."

The brain lesion, called an arteriovenous malformation (AVM), ranges in size from less than one to 10 centimeters in diameter. The defect can also occur in the spinal cord, and affects more than 300,000 Americans per year. While many patients show no signs of the abnormality, more than 10 percent experience debilitating symptoms. The untreated lesion can be fatal.

"The malformation looks like a wild tangle of snarled blood vessels," said Hoi Sang "Ben" U, MD, professor and neurosurgeon at UC San Diego Medical Center. "The clustering of arteries and veins deprives the rest of the brain of blood. Risks range from painful lingering headaches to massive hemorrhage."

As a "living" lesion that monopolizes the brain's blood supply, the malformation is difficult to remove. Capable of recruiting blood supplies from other vessels, the abnormality is stubborn, like a tumor, and will grow back if it is not entirely removed.

In the early days of the procedure, the UC San Diego surgical team was faced with removing the growth while protecting the brain from a sudden, potentially dangerous shift in blood flow.

Reducing Blood Flow

Prior to surgery, neuroradiologists attack the growth by embolizing, or plugging up, abnormal blood channels with particles of glue. During the process, a thin catheter is threaded through the leg's femoral artery and up into the brain. Once inside the brain, the catheter weaves through tiny vessels, often curving in hair pin turns, before reaching the center of the AVM. The neuroradiologist must be able to visualize the growth in a three dimensional space, making anterior and posterior turns that are only millimeters in length.

"Sometimes the vessel leads directly to the AVM and can be plugged fairly easily. Other times, the vessel leads to a healthy portion of the brain but has channels that branch off to feed the AVM," said Olson. "When you are treating an area of the brain that can impact speech and cognition, the stakes are high. Fortunately, at an academic medical center, we have the advantage of advanced training and new technologies to best treat our patients."

A Deep Sleep Anesthesiologists further refined the approach to the AVM by inducing a deep coma before and during surgery. The coma slows the metabolism of the body, reducing blood flow to the brain. By slowing the body's functioning, and causing a slow awakening from anesthesia, the brain has ample time to adapt to changes in blood flow.

"The barbiturate-based coma lessens the shock of removal of the AVM, giving the brain time to rehabilitate and heal. Then by progressively removing the growth over months, with multiple surgeries in shorter duration, the brain adjusts to the changes without harming the healthy surrounding brain," said U.

Removing the Lesion

"There are other options, such as radiation, to treat these malformations, but the results are temporary and will not obliterate the growth," added Drummond. "Today, with this surgery, you can compare angiograms and see permanent results. The AVM is gone, clean as a whistle."

AVMs develop in the embryo and often do not cause symptoms until the patient is in their 20s or 30s. Complications from the AVM may manifest as a range of neurological problems including headaches, seizures, and hemorrhage.

"Even if a person suffers a hemorrhage and appears to lose functionality, the damage may not be permanent. Patients can and do regain neurological function," said U. "The brain can wake up."

Waking Up the Brain Jeff Hogue, 29, a San Diego attorney, first experienced the effects of an AVM as an undergraduate student.

"The first headache was so intense that it was almost unbearable," said Hogue. "I remember thinking that something had to be wrong inside my brain."

Misdiagnosed as a migraine, the pain lapsed, only to return a decade later followed by stroke-like symptoms. "I was in my office and had writer's block which was unusual for me," said Hogue. "I tried logging into my email but my fingers stopped working. I could recall my password but my brain could not communicate with my fingers."

A trip to a local hospital revealed a 2-inch AVM.

"A surgeon recommended Dr. U to my family,saying that Dr. U was a surgeon he would choose for himself," said Hogue.

Hogue transferred to UC San Diego Medical Center for treatment. He arrived aware of his circumstances but unable to speak or write. Three surgeries later, he has recovered his speech and motor skills. He continues to practice real estate law and has recently returned from a Bali honeymoon.

"Treating the AVM is not easy but I am happy to be alive, no question," said Hogue.

"The AVM has disappeared from Jeff's angiograms," said U. "He is benefitting from a treatment that has evolved here at UC San Diego Medical Center for three decades. Generations of physicians have refined and taught this technique. This achievement is something you will only find within an academic medical center."

Media Contact: Jackie Carr, 619-543-6163, jcarr@ucsd.edu