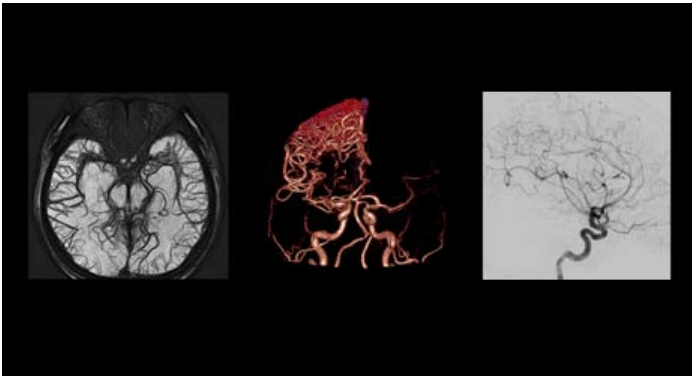


## AMERICAN STROKE MONTH

### Advanced Imaging Technology Aids in Stroke Diagnosis and Treatment



According to the American Heart Association, stroke is the leading cause of serious, long-term disability in the U.S., and it ranks third in causes of death. It is often said that “time is brain,” since the faster the clinician can detect areas of decreased blood flow and determine the optimal treatment plan, the better the patient’s chances for survival and recovery. Toshiba has a host of technologies that help medical professionals better diagnose and treat patients presenting with stroke symptoms.

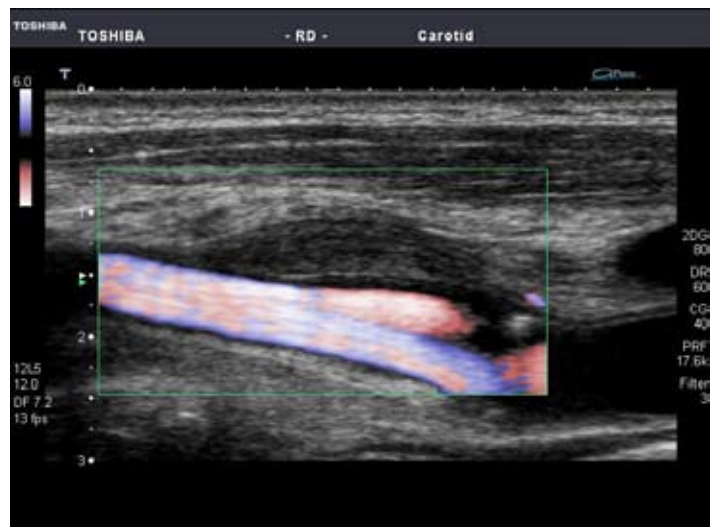
#### Ultrasound – Carotid Intervention

As with many other conditions, ultrasound is often the first modality physicians turn to when evaluating a patient presenting with stroke symptoms. It’s a key tool for evaluating the carotid arteries to identify the presence and type of plaque buildup the patient could have. Two key Toshiba features for ultrasound are particularly useful in stroke imaging.

*Precision Imaging:* This technology enhances image clarity and resolution to help physicians visualize plaque in the carotid arteries. Precision Imaging increases diagnostic confidence by providing more detailed ultrasound images so physicians can quickly determine the next steps in a patient’s treatment. As a multiresolution signal processing

technology, it not only evaluates images line by line but also includes information from adjacent lines to enhance the amount of information obtained. As a Toshiba exclusive software, Precision Imaging’s ability to capture information from multiple lines improves the definition of the structure, provides more detail and minimizes noise and clutter.

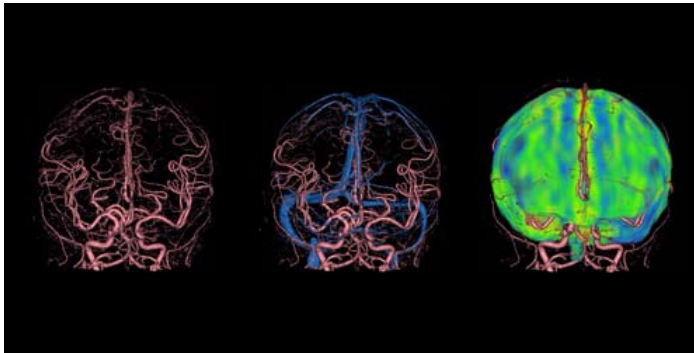
*Advanced Dynamic Flow™:* Advanced Dynamic Flow improves very high resolution for greater diagnostic confidence for vascular structures. This sensitivity helps to better visualize the degree of stenosis in the carotid arteries. Using the same ultra-high bandwidth normally used only in B-mode for doppler signal processing, Advanced Dynamic Flow simultaneously provides both high spatial resolution and high frame rates to accurately display flow with directional information, even in tiny vessels.



#### CT – Faster, Safer Stroke Assessment

When a patient comes to a hospital’s emergency department (ED) exhibiting stroke symptoms, it can take hours to diagnose and treat the patient, when time is of the essence. Toshiba’s Aquilion® ONE dynamic volume CT system has the ability to improve the quality of life for patients with neurological symptoms, especially related to stroke, by reducing diagnosis time to minutes with half the dose of conventional CT.

The Aquilion ONE allows physicians to reduce diagnosis time for life-threatening conditions such as stroke from hours or days to minutes. Unlike any other CT system available, the Aquilion ONE covers up to 16 cm of anatomy using 320 ultra-high-resolution 0.5 mm detector elements to image an entire organ, including the brain, in a single rotation. It can show the organ's dynamic blood flow and real-time function. The ability to see dynamic function, such as blood flowing through the brain, is critical for stroke patients in emergency settings and enables rapid and accurate diagnosis when time is critical. Coverage can also be collimated to a smaller area to reduce the dose to the patient.



This Neuro ONE acute stroke imaging protocol on Aquilion ONE combines non-contrast CT, cerebral blood flow analysis and four-dimensional digital subtraction angiography (DSA) into a single exam. By combining these exams into a single low-dose protocol, full stroke workup can be performed in less than five minutes.

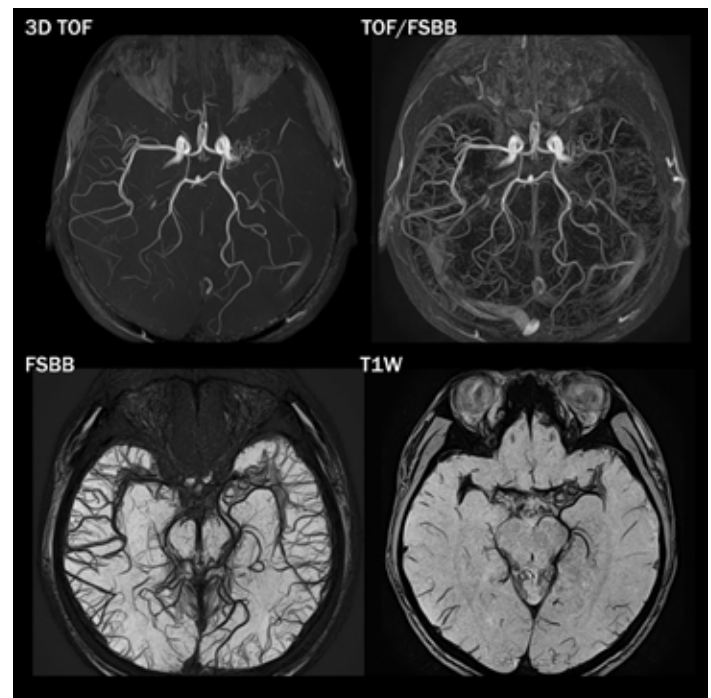
### **Magnetic Resonance – High-Sensitivity Stroke Imaging**

MRI is particularly beneficial for diagnosing acute ischemic stroke because it is highly sensitive to detecting microscopic changes in blood and oxygen in the brain. Toshiba MR integrates other techniques that further enhance MR's role in stroke diagnosis.

*Non-contrast techniques:* Not only are there safety concerns when imaging with gadolinium, but also having to add contrast injections to a stroke evaluation can take time that is not a luxury in these emergency situations. Toshiba offers the most robust suite of non-contrast techniques that are beneficial for stroke analysis. For example, the V-TRACE sequence can shorten brain imaging time.

*V-TRACE Sequence:* This non-contrast MRA sequence, available on all Vantage Titan™ and Vantage Atlas® MR systems, streamlines MRA brain imaging. The sequence acquires four image contrasts in one sequence, providing an imaging application for visualizing slow- and fast-flow vessels separately and together, as well as the brain tissue surrounding the vessels.

V-TRACE MRA is a dual-echo 3D FE sequence in which the first echo is acquired using Time-Of-Flight (TOF) and the second echo is acquired using Flow Sensitive Black Blood (FSBB). The sequence combines the advantages of both techniques to produce MRA images that depict blood vessels with both high and low velocity. The sequence design reduces the Specific Absorption Rate (SAR), which is a measurement of heat generated to the body during a MRI. Additionally, the TOF data can be used to evaluate the brain parenchyma. The images produced by the V-TRACE sequence improve the speed and accuracy of diagnosis.



*Patient-friendly features:* Toshiba's patient friendly MR features make imaging easier for the patient. Several features reduce the feeling of claustrophobia that often accompanies MR exams. For example, the Titan's large bore allows patients more room during the exam. Also, Toshiba's head coil – important in the imaging of stroke – has 10 elements and very high signal to noise, which means it

is not always necessary to utilize the top of the coil to image, reducing claustrophobia during an exam.

### **Infinix™-i Biplane Vascular X-ray System – Efficient Stroke Treatment**

Toshiba's Infinix-i biplane system has been developed with a number of tools to provide methods for neuro-interventionalists to develop treatment plans for patients more quickly. There are four key components of the system that make it ideal for stroke analysis.

*Two 12x12-inch detectors:* The midsize flat-panel detectors are ideal for brain imaging because they allow physicians to get two complete views of the cerebral vascular anatomy with each contrast injection, which not only helps to minimize the contrast load to the patient, but also provides better visualization due to the increased anatomical coverage when compared to two small detectors. Additionally, these midsize detectors allow physicians to obtain steeper compound angle views than can be obtained on systems with two large detectors.

*3D angio visualization:* This technology provides a three-dimensional image volume that can be rotated and manipulated in real time to ideally sort out superimposed vascular anatomy. Additionally, the two-dimensional multiplanar reformations enable physicians to dissect the image data from a variety of angles.

*Variable isocenter:* This key feature can dramatically improve patient safety during imaging. For example, some patients who are experiencing an aneurysm or subarachnoid hemorrhage may need a ventriculostomy to monitor and control intracranial pressure. Changing the table height in order to get the best imaging angles can present a dangerous challenge for physicians, because changing the table height can negatively impact the intracranial pressure and potentially injure the patient. Toshiba's lateral plane variable iso-center feature allows optimal positioning for imaging the brain, eliminating the need for table height adjustment, as is done on all competitive biplane angiographic systems. Physicians do not have to raise or lower the table to get the best angle, eliminating simple positioning as a concern for causing change in intracranial pressure.

*Five-axis positioner:* Toshiba's Infinix-i C-arm offers unprecedented patient access with a C-arm five-axis positioner that allows head-to-toe and fingertip-to-fingertip coverage. The freely moving components, ergonomically friendly design and five-axis positioner enable physicians to obtain optimal angles for neurological diagnosis and interventional procedures without repositioning the patient. Neuro-interventions typically are done with the patient under general anesthesia or heavy sedation, requiring anesthesia support during the procedure. The five-axis c-arm provides multiple setup configurations to provide unrestricted access to the head end of the table for patient care while preserving biplane projection capabilities.



### **SVD+ Helps to More Accurately Diagnose Stroke**

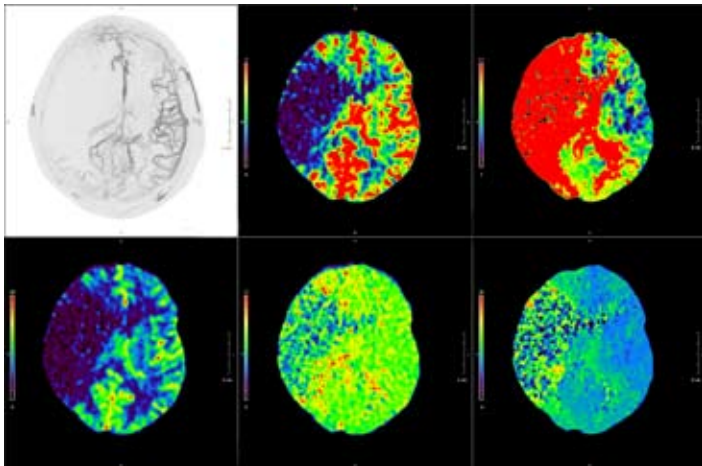
Toshiba's Aquilion® ONE dynamic volume CT system has changed the scope of brain perfusion analysis by enabling dynamic imaging of the entire brain and dramatically improving the ways physicians diagnose and treat stroke. One feature, available only on the Aquilion ONE, due to its ability to image the entire brain in one rotation, is the Singular Value Decomposition Plus (SVD+) perfusion algorithm. The SVD+ algorithm produces advanced CT perfusion imaging that is unmatched in the industry.

"The Aquilion ONE dynamic volume CT system with the SVD+ perfusion algorithm is emerging as a new standard of care for brain perfusion analysis," said Erin Angel, PhD, manager, CT Clinical Science,

Toshiba. “The fast exam time, high image quality and lower radiation doses of the Aquilion ONE, combined with the more accurate perfusion analysis produced by SVD+, are changing the ways physicians identify and treat stroke quickly.”

### **Toshiba’s SVD+ Perfusion Algorithm**

Brain perfusion imaging in CT is used to determine if the patient has had a stroke, and to distinguish which areas of the brain are beyond repair and which areas of the brain may be saved through intervention. Perfusion analysis can help clinicians estimate treatment response and develop therapeutic pathways designed specifically for individual patients. The advanced SVD+ algorithm was developed for the Aquilion ONE to improve the quantitative maps produced by perfusion imaging and to give physicians more accurate data for the evaluation of stroke.



Standard SVD algorithms can sometimes produce perfusion maps that are not completely accurate, since they have difficulty calculating certain delays in blood flow. These blood flow delays, if not identified appropriately, produce perfusion maps that provide unclear results to the physician. Toshiba’s SVD+ is an advanced perfusion algorithm that eliminates these issues. SVD+ is a delay-insensitive SVD algorithm that uses an innovative technique to account for delays in blood flow and perform calculations with faster computation times. The SVD+ algorithm is unique in that it always begins prior to the contrast’s arrival to more accurately quantify the region of the brain being imaged.

## **Aquilion ONE Enables Physicians to Prevent Stroke**



Pamela Louderback, a grandmother from Taylor Mill, Ky., had been experiencing dizzy spells for months. Although she attributed the episodes to a previous condition, physicians could not accurately diagnose her. Pamela had suffered complications from a surgery, and her left carotid artery had to be completely closed. Pamela suspected that her dizziness was caused by blockages in her right carotid artery, but doctors were unable to confirm her belief.

She went about her daily routine, until one day, after blacking out at work, Pamela found herself at St. Elizabeth Healthcare’s emergency room (ER). Unbeknownst to her and her doctors, she was on the verge of suffering a stroke.

According to Dr. Jeff Dardinger, director of Imaging, Vascular Institute, St. Elizabeth Healthcare, a typical patient presenting with these symptoms would have to undergo a battery of tests and be admitted to the hospital before a diagnosis could be made. For example, a patient would likely have had a CT exam of the head and neck and been admitted to the hospital while an MRA exam was scheduled. After a consultation the next day, the patient would have the MRA. According to Dr. Dardinger, this process could take anywhere from two to four days. For anyone who has had a stroke or knows someone who has, you know this timetable can prove fatal or debilitating.

Fortunately for Pamela, she was taken to St. Elizabeth – the first hospital in Kentucky to purchase an Aquilion® ONE. Because of the Aquilion ONE’s

ability to capture the entire brain in one rotation, as well as its ability to show function over time, physicians diagnosed Pamela within an hour and prevented a stroke from occurring at all. This system is ideally suited for detecting neurovascular conditions quickly. It uses 320 ultra-high-resolution detector rows to capture up to 16 cm of coverage, enough to image the entire brain or heart and show organ movement.

Images confirmed that Pamela's right carotid artery was 90 percent occluded, which significantly reduced blood flow to the brain. By diagnosing this condition within the hour, physicians immediately planned stent treatment to open the artery passage, preventing a stroke.

"Toshiba's Aquilion ONE allowed us to accurately diagnose the patient quickly, dramatically improving her quality of life," explained Dr. Dardinger, who interpreted Louderback's images. "Without dynamic volume CT, the patient would have undergone a series of tests for two to four days, at a minimum, to uncover the occlusion. Being able to diagnose the patient within an hour allowed us to plan treatment immediately and prevent a stroke from occurring."

"I truly believe this system saved my life," explained Louderback. "I had several exams over the past few months, none of which could detect why I was having dizzy spells. It wasn't until I was imaged in the ER, using the Aquilion ONE, that a definitive answer could be found."

Introduced in November 2007, dynamic volume CT scans an entire organ in a single pass and produces 4D videos that show an organ's structure, its movement and its blood flow. In comparison, a 64-slice, 128-slice or 256-slice CT scan can capture only a portion of an organ in a single pass, requiring physicians to "stitch together" multiple scans of an organ to get a full image. The new technology helps reduce multiple exposures to radiation and exam time.

Designed for today's healthcare environment, the Aquilion ONE reduces overall healthcare costs and streamlines diagnosis by replacing several tests with a single, comprehensive exam. The Aquilion ONE's single exam helps reduce unnecessary test-

ing, as well as the accompanying accumulative radiation and contrast dose.

"The Aquilion ONE can dramatically improve patient care by providing a fast, comprehensive exam for patients suffering from life-threatening conditions, like stroke and heart attack, while helping to lower healthcare costs," explained Robb Young, acting director, CT Business Unit, Toshiba. "St. Elizabeth Healthcare is an excellent example of where the Aquilion ONE enabled physicians to diagnose and treat a patient before a serious stroke occurred."

## Clinical Case of the Month: Acute Stroke

A stroke occurs when a blood clot clogs an artery or a blood vessel ruptures and interrupts normal blood flow to the brain. When a person suffers a stroke, their brain cells may begin to die and brain damage can occur, affecting normal brain activity that controls speech, movement, and memory. Stroke sufferers often experience sudden trouble speaking or understanding, sudden numbness in the face, arm or leg, sudden dizziness with trouble walking or balancing, and/or sudden severe headache.

According to the American Heart Association, stroke is the third leading cause of death, ranked behind heart disease and cancer. In 2006, over 137,000 people died as a result of stroke, and studies show that approximately 795,000 people suffer a new or recurrent stroke each year (~75% first attacks and ~25% recurrent)<sup>1</sup>.

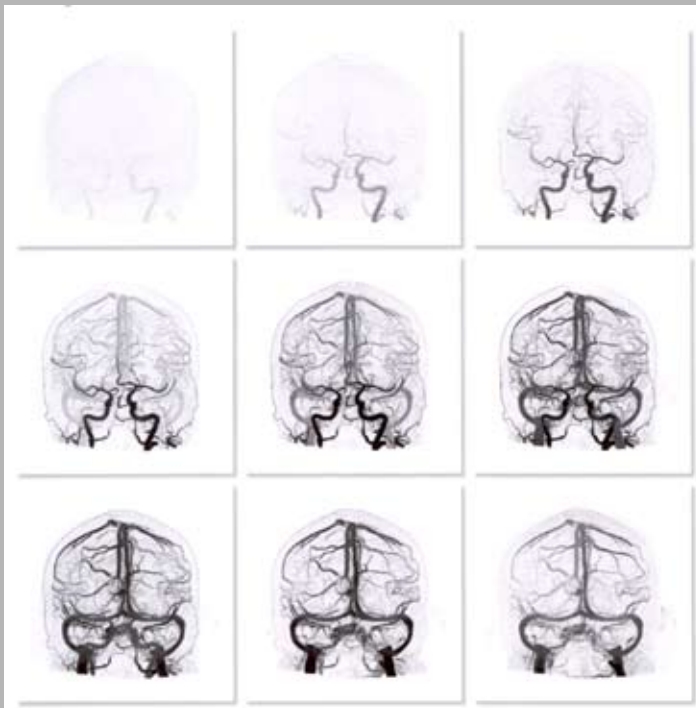
Computed Tomography (CT) scans are commonly used to diagnose stroke because they easily detect bleeding inside the brain and can be performed quickly to prevent further brain damage. Toshiba's Aquilion ONE® 320-detector row dynamic volume CT scanner has the ability to reduce diagnosis time from hours or days to minutes by imaging an entire organ, such as the brain, in one rotation and show dynamic blood flow in real-time, critical for stroke patients.

**Case Study:** CT DSA, Brain Perfusion, and 3D TTP maps using dynamic volume CT was used to diagnose this acute stroke.

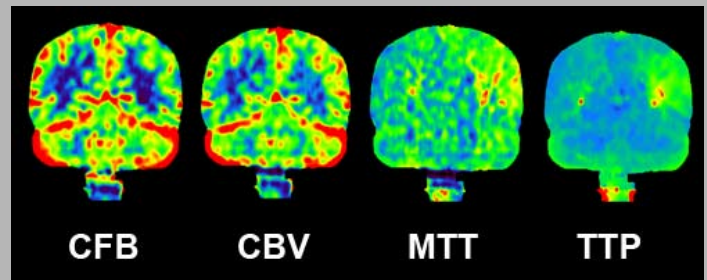
**Technology:** Toshiba Aquilion ONE 320-detector row dynamic volume CT.

**Patient History:** A 76-year-old woman was having dinner when she noticed difficulty finding words and with her speech. She called her internist, who advised her to take 325 mg of aspirin and go to the emergency room (ER). By the time she reached the ER, her symptoms had resolved. She was admitted for further evaluation and management. The acute stroke imaging protocol on the Aquilion ONE CT system was requested as a matter of priority. All diagnostic information was provided to the physician in 4.5 minutes.

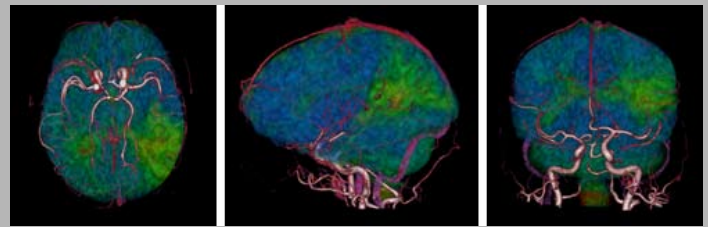
**Image Gallery:**



The CT DSA images clearly demonstrate near-complete occlusion in the inferior division of the left MCA at the M2 level, with collateral flow and reconstitution of some MCA branches distally. These images were generated automatically with perfect bone subtraction.



Abnormal perfusion is demonstrated in the left posterior temporal and parietal regions, characterized by increases in TTP and MTT, with a decrease in CBF. The CBV within this lesion is increased, indicating good autoregulation.



The fused 3D TTP maps are excellent for showing the anatomical relationships of the occluded MCA branch and the resultant perfusion deficit.

*Images courtesy of Millard Filmore Gates Circle Hospital*

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