



Vascular anatomy of the hand using Toshiba's fresh blood imaging technique and processed on the Virtual Explorer workstation. courtesy Toshiba America Medical Systems Inc.

A Technologist's Guide to **Eliminating Contrast**

Amid growing concern over gadolinium-based contrast agents, a technologist offers a guide to going contrast-free **By Dawn Berkeley, RT(R)(MR)**

Many professionals in medical imaging are aware of the recent FDA black box warning on the use of gadolinium-based contrast agents, as well as the medical findings linking gadolinium to the rare, sometimes fatal disease nephrogenic systemic fibrosis, (NSF). As a result, there is a growing concern among physicians, technologists and even patients regarding the use of gadolinium-based contrast agents during MRA exams. This concern is further heightened by the common practice of using double and even triple-dose protocols for gadolinium-enhanced MRA.

Recent studies have directly linked gadolinium to NSF in patients with renal insufficiency, citing that approximately 95 percent of patients with this skin disease received gadolinium prior to the disease's onset. There is also concern that the cumulative dose-effect of multiple contrast-enhanced MR exams over a lifetime amplifies risk, potentially leading to NSF in patients with healthy renal histories at the time of

administration. However, tracking cumulative contrast doses is extremely difficult for healthcare professionals, making MRA exams that do not require contrast agents an even more attractive alternative.

THREE TECHNIQUES

While most MR vendors are actively pursuing research for the development of non-contrast techniques for MRA, Toshiba America Medical Systems Inc. is one company with contrast-free techniques available, allowing MRA exams without the use of contrast agents. These techniques include fresh blood imaging (FBI), contrast-free improved angiography (CIA) and time-spatial labeling inversion pulse (Time-SLIP).

At Omega Imaging, we frequently incorporate contrast-free MRA into our vascular protocols, because we have found these techniques to be beneficial in providing safer MRA exams to patients while still capturing high-quality diagnostic images.

But before discussing the contrast-free techniques currently available, it is impera-

tive to understand why these techniques are important and compelling to use. Although the FDA has not cleared gadolinium-based contrast agents for use with MRA exams, they have been widely used for MRI and MRA exams since their introduction in 1988. At that time, gadolinium was considered to be non-nephrotoxic and its off-label use for MRA was commonplace.

Prior to the introduction of the gadolinium-based contrast agents used today, time-of-flight and phase contrast were the standard contrast-free techniques used during most MRA exams. These techniques were used less frequently with the advent of contrast agents, which greatly enhanced the imaging of blood vessels during exams. As technology improved and scanners benefited from quicker acquisition times, the industry quickly adapted gadolinium-based contrast agents, despite the "off-label" use.

LESS TIME, LESS RISK

Contrast-free protocols have improved since the first generation of contrast-free

techniques. At Omega Imaging, we performed comparisons between the older conventional contrast-enhanced exams and the new contrast-free techniques. We have determined that FBI, CIA and Time-SLIP techniques take less overall time than contrast-enhanced procedures, produce outstanding image quality comparable to—if not better than—contrast-enhanced images and helps reduce the patient risks associated with gadolinium-based contrast agents.

The FBI technique is very sensitive to slow flow and is well-suited for evaluating peripheral vascular diseases of the lower extremities. Based on an ECG-gated 3D FASE (fast advanced spin echo) technique, FBI acquires arterial and venous flow in a single acquisition, requiring less overall scan and setup time than other MRA techniques. It also eliminates sensitivity to issues including improper timing, turbulent flow and differential filling that can cause contrast-based MRA to fail.

The second generation of FBI techniques is contrast-free improved angiography (CIA). CIA builds on the advanced FBI technique and is designed to provide easier acquisition of information and superior imaging of small vessel detail. By adding appropriate flow spoiler pulses to complete systolic black blood imaging, arterial and venous flow separation is improved. CIA also retains the advantages of reduced scan times and outstanding background tissue suppression, while expanding the window of opportunity for early disease evaluation.

CIA is most commonly used for runoff exams of the lower extremities, and enables technologists to image the venous and arterial flow in one acquisition. Once the image data is acquired, it is automatically separated during post processing, eliminating the need for operator dependent manipulation, as well as the need to perform two separate scans. Additional benefits include increased technologist productivity, reduced patient scan times and increased patient comfort.

The final contrast-free technique we employ is time-spatial labeling inversion pulse (Time-SLIP), which can be applied to many regions of the body for evaluating hemodynamic velocity functional assessments and visualization of complex vascular structures. This technique employs spatially

non-selective IR pulses and spatially selective tag pulses to reveal vascular anatomy excited as bright or black blood. It can be used with FASE or TRUE SSFP sequences in gated, two- and three-dimensional acquisitions. Time-SLIP can be performed as a free-breathing technique, extending this option to the elder and pediatric age groups, as well as patients with respiratory difficulty.

Time-SLIP technique is especially desirable for patients with compromised circulations and renal flow problems. For example, often with contrast-enhanced techniques, the renal parenchyma quickly absorbs the contrast and may obscure portions of the renal arteries. Using Time-SLIP, more renal vasculature is depicted in greater detail.

WEIGHING THE BENEFITS

Whether you are using an MRI-compatible pressure injector or injecting by hand, the act of injecting often presents challenges.

Once the contrast is successfully injected, there is a limited window to image the patient and gather the information correctly. Acquiring images at the precise moment when the bolus is moving through the target region is challenging. FBI, CIA and time-SLIP contrast-free techniques greatly expand the window for image acquisition and reduce the guess work because there is no bolus to chase.

A common misconception about contrast-free MRA is that the procedures are more time-consuming and difficult. This is simply untrue. While actual scan times are slightly longer, the overall procedure time is less than traditional contrast scans, as there is no IV setup or take-down time. The contrast-free techniques are very easy to learn and produce consistent image quality. These techniques, which are safer for patients by avoiding contrast exposure, make it easy for technologists to reproduce successful contrast-free exams consistently.

Another benefit is accuracy. Without using contrast, technologists are not restricted to catching the bolus in a short, rigid timeframe. Contrast-free imaging results in higher image quality, greater flexibility, better visualization of smaller vessels and improved diagnostic accuracy.

Contrast-free MRA exams help elimi-

nate extravasation, a condition in which a patient's blood vessel bursts, releasing hazardous contrast materials under the skin and into the body. Most technologists have dealt with extravasations at least once, especially when working with diabetic patients with fragile, thin veins. Using contrast-free techniques on these patients eliminates this risk.

When contrast agents are required for a specific MR exam, we often use contrast-free techniques in tandem with conventional techniques, helping to ensure we are capturing the highest quality images with maximal diagnostic content while subjecting the patient to less anxiety and pharmaceutical stress. Incorporating these supplemental MRA techniques also helps eliminate the need for "retakes," which can be time-consuming and costly.

There are also major cost savings associated with contrast-free MRA. Contrast agents are fairly expensive, and in procedures where double and triple doses are used, the price can increase substantially. The IV setup of contrast injection also incurs additional costs such as syringes, needles and other necessary items. Given the high cost of contrast agents and their limited reimbursement, contrast-free MRA techniques can be extremely cost-effective for imaging centers and hospitals.

As a technologist, it is important to stay abreast of the latest medical studies and educate yourself on methods to improve patient care and safety. These contrast-free techniques, FBI, CIA and time-SLIP, are extremely easy to understand, and with some simple training, could be easily used in your imaging center or hospital.

There are still uncertainties surrounding the dangers of gadolinium and its connection to NSF. Until more is known, we prefer to offer patients the option of contrast-free MRA exams whenever possible. Not only are contrast-free MRA techniques safer for patients, but are extremely reliable, less time-consuming and less costly, making them a sound, ethical choice. ■

Dawn Berkeley, RT(R)(MR), is an MRI technologist at Omega Imaging in Mission Viejo, Calif. She can be reached at d.berkeley@hotmail.com.