

IMAGE OF THE MONTH

Power injection of contrast through an intravenous line during MRI is frequently used to assess cerebral perfusion in adults, but use of this technique in neonates is problematic for a number of reasons, according to Dr. Ellen Grant, director of pediatric radiology at Massachusetts General Hospital in Boston.

Many contrast agents used for MRI are not specifically indicated for very young children. The IV line also may be placed in an awkward or precarious position and may not be suitable for bolus injection.

"The other problem with these bolus injections of contrast for perfusion used on adults is that they emphasize all of the [cerebral] vessels. Neonates have relatively large veins on the cortical surface so that's all you see—cortical veins. I don't

get much information about [deeper] cortical perfusion," said Dr. Grant.

Arterial spin labeling MRI (ASL-MRI) eliminates the need for the injection of a contrast bolus by magnetically labeling blood that flows from the heart past an external radiofrequency pulse sequencer placed at the infant's neck. The magnetically labeled blood perfuses into the brain tissue, altering the tissue's magnetization. By making assumptions about a few parameters, such as the distance between the point of blood magnetization at the neck and any given point in the brain, the technique can be used to produce quantitative maps of cerebral blood flow, such as the image seen at right.

"I think the most important thing is that it gives you more reproducible data than

the bolus perfusion method. It's easier to compare subject to subject or one subject over several time points," said Dr. Grant.

Another advantage of this method over a contrast bolus is that the blood is tagged right as it goes into the brain, instead of having to go through the heart and lungs, which spreads out the bolus.

ASL-MRI is "kind of like a poor man's look into brain function because it's blood flow, which is linked to metabolism," said Dr. Grant.

The technique reveals injury in areas that looked normal on diffusion-weighted imaging," said Dr. Grant. "We want to know not only what's happening to the area that shows up as necrotic on a diffusion scan, we want to know what's happening to the rest of the brain."

This information may be particularly important in the neonatal brain because

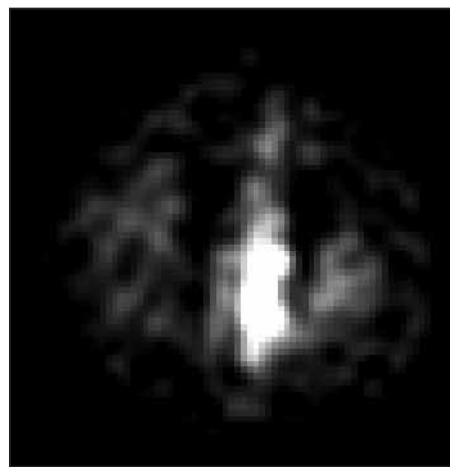
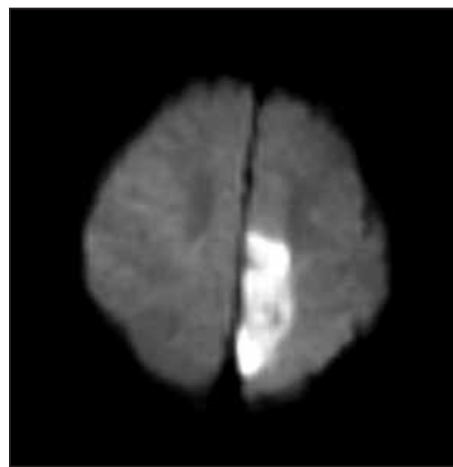
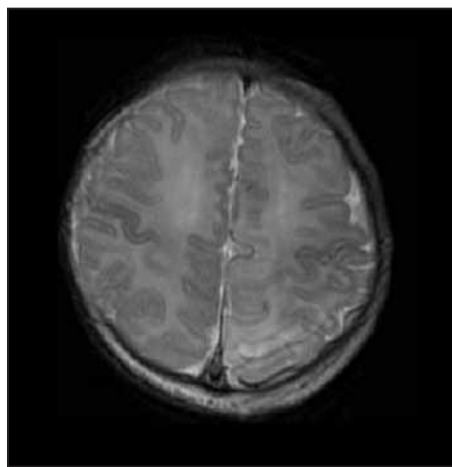
animal models of neonatal brain injury indicate that apoptotic cell death is often the predominant form of cell death. "We know that diffusion-weighted imaging picks up necrotic cell death but we're probably not picking up that other possibly dominant proportion that is apoptotic," said Dr. Grant.

Dr. Grant uses a 1.5-T scanner to image infants, who have been fed and swaddled tightly so that they fall asleep. "Having 3 tesla does give you increased signal to noise but with the ASL sequence we have from Dr. David Alsop [of Harvard University in Boston], we get good signal at 1.5 T," said Dr. Grant. One advantage in imaging babies is that blood flow is much faster than in adults. "Even in a newborn I'm getting decent images that I can start to see different patterns of blood flow with different types of injuries," she said. The sequence, written by Dr. Alsop, is fast-spin echo-based, and it provides whole-brain coverage rather than a few slices. The process takes 5-6 minutes.

ASL-MRI will help researchers better understand the health of neurons not identified as injured using conventional scanning techniques. Dr. Grant and her colleagues are starting to couple blood-flow imaging with quantitative optical imaging to come up with estimates of the cerebral metabolic rate of oxygen, which can reveal the functional status of brain tissue.

The technique may prove to be useful in the early stratification of neonates and infants with developmental delays without exposing them to radiation, said Dr. Grant.

—Kerri Wachter



PHOTOS COURTESY DR. ELLEN GRANT

Stroke injury in a neonate is difficult to discern on T2-weighted MRI of a neonate (left). The diffusion-weighted image (center) shows an intense area of stroke injury. ASL-MRI shows the same stroke injury seen on DWI and areas of less intense injury.

Depression, Medical Problems Dog Hydrocephalus Shunts

BY SHERRY BOSCHERT
San Francisco Bureau

SAN FRANCISCO — Shunt revisions are necessary in a "startlingly high rate" in patients with hydrocephalus diagnosed in infancy or childhood, Dr. Nalin Gupta said at the annual meeting of the American Association of Neurological Surgeons.

Like the need for shunt revision, infections and functional problems continued into adulthood, judging from the findings that a retrospective study of 1,459 patients found.

"By focusing on surgical complications, we underestimate the impact of hydrocephalus. Lifelong medical treatment and complications are to be expected," said Dr. Gupta.

He and his associates studied survey responses collected by the Hydrocephalus Association from 1,459 people with pediatric diagnoses of hydrocephalus. The data included 10-year follow-up information for 718 respondents, and 403 of these were at least 20 years of age at the time of the survey.

Most respondents developed hydrocephalus during gestation or in infancy, with 16% diagnosed before birth and 42% diagnosed before 18 months of age, said Dr. Gupta, chief of pediatric neurological surgery at the University of California, San Francisco.

Shunts to treat hydrocephalus were placed in 97% of cases. Approximately 31% of respondents had between 1 and 10

shunt revisions. Among 581 people diagnosed with hydrocephalus before 18 months of age, only 8% reported no shunt revisions; another 25% underwent more than 10 shunt revisions, he said. People who reported more than 10 shunt revisions had a median age of 21 years; most were in their 20s.

Hydrocephalus diagnosed later in childhood also was associated with a high rate of shunt revisions. Among 137 people diagnosed after 18 months of age, 15% needed no shunt revisions, 23% underwent more than 10 revisions, and the rest fell in between.

Shunt-related infections were common as well. One or two infections were reported by 29% of respondents; among a subset of patients diagnosed before 18 months of age, at least a third reported one or two infections, and a small percentage reported many more infections, Dr. Gupta said.

The proportions of shunt revisions exceeds what is reported in the literature for hydrocephalus diagnosed in childhood, and the proportion of infections is higher than what physicians usually describe to families contemplating shunt placement, said Dr. Timothy B. Mapstone, who discussed the study at the meeting. The true

extent of revisions and infections probably is even worse, he added.

The data emphasize the need to be sure that a shunt is needed before placing one, said Dr. Mapstone, the Harry Wilkins Chair in neurosurgery at the University of Oklahoma, Oklahoma City.

Other complications, including shunt breakage, overdrainage, and subjective symptoms, were reported by 36% of respondents. "To me, this was an unacceptable rate of complications associated with this disease," Dr. Gupta said, noting the study's design limits its usefulness.

Respondents who were diagnosed with hydrocephalus during infancy were more

likely to report being depressed or to have used special assistance in school, and were less likely to be married, have children, be employed, or have a driver's license, compared with those diagnosed after 18 months of age.

Among a subset of 403 respondents currently aged 19-45 years who were diagnosed with hydrocephalus before age 19 years, a majority reported being depressed and 37%-45% reported receiving treatment for depression, depending on their age at diagnosis. Fewer than 25% had completed a college education.

The respondents were 53% male, and 85% were white. ■

Functioning After Pediatric Hydrocephalus

Age at Diagnosis

	0-18 months (n = 305)	19 months-12 years (n = 56)	13-19 years (n = 42)
Reported depression	71%	64%	53%
Were treated for depression	45%	37%	38%
Reported substance abuse	9%	15%	2%
Got special school services	46%	43%	26%
Completed high school	24%	13%	14%
Have a driver's license	60%	80%	93%
Were employed	57%	63%	81%
Were denied insurance at some time	72%	80%	73%
Live alone	19%	16%	19%
Live with parent or relative	41%	36%	29%

Note: Based on people now aged 19-45 years.
Source: Dr. Gupta and his associates

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