factsheet

Tuberous Sclerosis Alliance

NEUROIMAGING IN TUBEROUS SCLEROSIS COMPLEX*

Neuroimaging is one of the most important tools in the diagnosis and management of tuberous sclerosis complex (TSC). This involves either computerized tomography (CT) or magnetic resonance imaging (MRI) scans of the brain. The most common findings include **cortical tubers**, **subependymal nodules**, and **giant cell astrocytomas**.

After the diagnosis has been made, periodic follow-up scans may help identify areas of change or deterioration. These techniques will be described in this Fact Sheet, as well as their usefulness and limitations in persons with TSC. In the last part, the recommended technical factors for performance of CT and MRI scans in TSC patients are listed.

COMPUTERIZED TOMOGRAPHY

CT scans produce a picture of the brain by directing a beam of X-rays through the targeted area at many different angles. A detector measures how much of the beam comes out on the other side. A computer then constructs a cross-sectional picture of the brain, based on many hundreds of readings from the detector. CT scans take less time than MRI's. In fact, some machines can scan the brain in as little as 25 seconds. Nonetheless, it is important that a person hold as still as possible during the scan, so that the best possible pictures can be obtained.

CT scans can show tumors, but usually not as clearly as an MRI. Build-up of fluid in or around the brain (hydrocephalus) can also be seen well on CT scans. Because they can be performed relatively quickly and are more easily available than MRI's, CT scans can help to exclude a major abnormality or dramatic change, such as tumor growth or hydrocephalus. When a person with TSC has a sudden change in behavior, increase in seizures or the abrupt onset of severe headaches, this can sometimes indicate that there has been such a change and may warrant the need for a scan.

Disadvantages include lower resolution than MRI's; the need for exposure to radiation (albeit at very small doses); and the need for sedation in patients who cannot hold still. Also, adults rarely need sedation for a CT scan.

MAGNETIC RESONANCE IMAGING

MRI's involve placing a person in a tube inside a very strong magnet. MRI's provide a much more detailed picture of the brain. They can also be used to identify blood flow, chemical composition, flow of spinal fluid and blood vessels in various areas of the brain. They can identify tubers much better than CT scans; particularly using a technique called FLAIR (fluid attenuated inversion recovery).

Contrast (dye) is usually given to help determine if a subependymal nodule is beginning to grow into an astrocytoma. An MRI is better able to assess any changes in tubers, tumors, or subependymal nodules that can occur over time. An MRI scan does take much longer than a CT scan, as long as 45 minutes to an hour. Some special scans may take even longer.

It is also more expensive. The space in the magnet for the person being scanned is rather small, and many people get claustrophobic. So-called "open" MRI's have magnets that are open on the sides, and are less confining. However, their image quality is poor, and they are not desirable for use in people with TSC.

It is very important to hold perfectly still during an MRI, as the pictures are easily distorted by movement. Most children and many adults will require sedation. An advantage is that an MRI does not require exposure to radiation. This can be important since many people with TSC need to have several brain scans over a lifetime. In fact, some centers do brain scans as often as every year until puberty.

SEDATION

Many people will need to be sedated for one or both of these techniques. It is critical that sedation be performed safely and by experienced personnel, but also that it be sufficient for the patient to remain asleep throughout the entire procedure. Taking mild sedatives prescribed by a family doctor are almost always inadequate. In fact many people become more anxious or agitated when they receive such a medicine. Since CT scans without contrast are so quick, sedation is often not necessary. Scheduling a scan when a child is already sleepy or just after an infant has been fed ("milk sedation") can be very useful.

For MRI scans, infants and young children are often sedated with an oral medicine called **chloral hydrate**. Older children usually need intravenous sedation. Certain people may require an anesthesiologist to be safely and adequately sedated. Whichever

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technique is employed, it is important to be sure that the staff at the scanning facility is thoroughly trained and able to handle any problems that may arise. This is particularly true for infants and children.

RECOMMENDED TECHNICAL FACTORS FOR PERFORMANCE OF CT AND MRI SCANS IN TSC
You may wish to share these with your doctor or radiologist:

CT: 5 mm sections through the posterior fossa and 10 mm sections through the supratentorial brain pre- and post-contrast.

MRI: Field Strength 1.5 Tesla
Sequences: Sagittal T1
Axial T2 pre- and post-contrast
Axial T2
Axial FLAIR
Coronal T1 post-contrast
Proton MR Spectroscopy using PRESS of a cortical tuber and any large or changing subependymal nodule

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**For the longer, more technical version of this "Fact Sheet", please contact the Tuberous Sclerosis Alliance.*