Key Points

1. Although the exact mechanisms behind syrinx formation are not known, it is believed that arachnoid scarring in the region of a syrinx plays a role
2. Some surgeons treat syrinxes due to scarring with a decompression at the level of the syrinx
3. Study from Germany showed that an MRI technique known as CISS is more effective at imaging arachnoid scarring and blockages than conventional MRI
4. Study involved 59 adult patients with syringomyelia who underwent both conventional and CISS MRI
5. Two independent neuroradiologists reviewed the films for ability to differentiate tissue from CSF and the presence of artifacts
6. Overall, the CISS images were able to more clearly define the subarachnoid space and thus show blockages
7. CISS is not good at showing syrinxes in the tissue of the cord and so is a supplement to standard MRI, not a replacement
8. Authors believe CISS should be used when scarring is suspected, for idiopathic syrinxes, and to differentiate a central canal remnant from a syrinx

Definitions

artifact - in imaging refers to something on the image which isn't actually there; essentially an error

arachnoid - thin middle layer of the covering of the brain and spinal cord

central canal - tube like, center of the spinal cord; the central canal is open in young children but closes as people age

MRI Technique Provides More Detail Imaging A Syrinx

May 31, 2008 -- While there are many theories on syrinx formation, the precise mechanism (or mechanisms) behind why syrinxes form and grow is not known. Many theories, however, focus on the disruption of the natural flow of cerebrospinal fluid (CSF), either at the top of the cord as with Chiari, or lower in the cord such as due to scarring.

Chiari patients are of course familiar with how the herniated cerebellar tonsils of Chiari can block the flow of CSF from the brain to the spine and back, but they may not be aware that it appears that syrinxes can also form from local blockages at different levels of the spine. Recall that CSF flows in what is known as the subarachnoid space (SAS) which exists between the actual tissue of the brain/spine and the thin arachnoid layer of the meninges. Normally the CSF flows freely in this space, but in some cases the arachnoid can become scarred and create small blockages that disrupt the CSF flow. This can occur due to infection, trauma, and sometimes postoperatively and can lead to the development of a syrinx.

In cases where such scarring is clearly evident on MRI, surgeons will often attempt to treat the syrinx by performing a local decompression around the syrinx. This can entail removing some bone and freeing the arachnoid adhesions and scars in order to enable the flow of CSF.

With this in mind, a group of researchers from Germany (Roser et al.) recently announced in the May, 2008 issue of the Journal of Neurosurgery: Spine that an MRI technique known as 3D constructive interference steady state (CISS) is more effective at showing blockages in the subarahcnoid space than conventional MRI.

MRIs are amazing devices which can be configured and programmed to collect and analyze data in many different ways. Some radiologists and medical physicists spend their careers researching different MRI techniques and how they can be applied to different diseases. In this case, the German researchers chose a technique which was developed in the early 1990s and has been used in evaluating a variety of conditions, such as trigeminal neuralgia.

In order to compare the 3DCISS to more conventional MRI, the researchers studied 59 adult syringomyelia patients who were thought to have syrinxes associated with arachnoid scarring. The majority of the cases (41) were due to trauma, although it is important to note that only a small number were major spinal traumas and that most were minor traumas with no neurological problems immediately following the initial event. In addition, there were 17 cases of Chiari related syringomyelia, where new syrinxes had developed post-operatively and were thought to be due to scarring. Finally, there was one case due to arachnoid inflammation associated with an infection. The syrinxes were of varying sizes and locations (Figure 1).

Figure 1:
Syrinx Location (59 Patients)

Cervical	38%
Cervicothoracic	27%
Thoracic	22%
Thoracolumbar	4%
Holocord	9%

Each patient underwent both conventional MRI and the CISS technique in the area of their syrinx. Two independent neuroradiologists then evaluated the quality of the scans in several areas:

1. The ability to differentiate tissue from spinal fluid
2. The presence of motion artifacts
3. The presence of artifacts induced by the flow of CSF

In MRI images, artifacts refer to things on the image which shouldn't be there. For example, when a person getting an MRI moves or coughs, it can create errors in the image and these are referred to as motion artifacts. In addition to the human review, the researchers also used a quantitative technique to assess the amount of noise in each type of image.
Both the qualitative and quantitative analysis showed that the CISS technique was superior in providing accurate images of the subarachnoid space and associated scarring. Figure 2 (below) shows an example of a CISS MRI image where the white arrows show the presence of arachnoid blockages at the level of a syrinx. The

cervical - upper region of the spine; neck area

holocord - spanning the entire spinal cord

hydromyelia - refers to a dilation of the central canal, sometimes used interchangeably with syringomyelia

idiopathic - due to an unknown cause

lumbar - lower part of the spine

meninges - layers which cover the brain and spine

MRI - magnetic resonance imaging; diagnostic device which uses powerful magnets to create detailed images of inside the body

subarachnoid space (SAS) - space underneath the arachnoid layer in which CSF flows

syrinx - fluid filled cyst in the spinal cord

thoracolumbar - refers to a scoliosis curve which starts in the thoracic region but extends to the lumbar region

thoracic - middle part of the spine, chest area

cerebellar tonsils - portion of the cerebellum located at the bottom, so named because of their shape

cerebrospinal fluid (CSF) - clear liquid in the brain and spinal cord, acts as a shock absorber

syringomyelia - condition where a fluid filled cyst forms in the spinal cord

Source

Roser F, Ebner FH, Danz S, Riether F, Ritz R, Dietz K, Naegele T, Tatagiba MS. Three-dimensional constructive interference in steady-state magnetic resonance imaging in syringomyelia: advantages over conventional imaging. J Neurosurg Spine. 2008 May;8(5):429-35

conventional MRI image at this same level did not reveal the blockages.

Figure 2: 3DCISS MRI Image

Note: White arrows shows arachnoid blockage which was not visible on standard MRI.

To highlight the usefulness of the CISS technique, the authors point out that the images revealed scarring around the syrinxes in 11 patients which enabled surgeons to perform microsurgical decompressions. In nine of the cases, the syrinxes collapsed within days of the surgery.

The authors believe the CISS MRI technique can be used in several ways to enhance treatments. One way, as noted above, is to help surgeons plan local decompressions. A second way is to help identify the underlying cause in otherwise idiopathic cases of syringomyelia. Finally, the technique can be used to differentiate between what are called slit-like syrinxes - which are really just remnants of the central canal which did not close - and true syrinxes which will lead to problems.

However, the authors also stress that the CISS technique has limitations and is not a replacement for the conventional MRI, but rather an enhancement. Specifically, the CISS does not do a good job of imaging a syrinx in the actual tissue of the spinal cord. It is also susceptible to motion by the patient and takes longer to acquire images than a conventional technique. Hopefully neurosurgeons will recognize the benefits of CISS MRI and begin to use it as a supplement when appropriate.

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