MR Perfusion Study of the Cervical Spinal Cord
--------A new approach by PRESTO pulse sequence--------

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Purpose
The purpose of this study was to evaluate the possibility and usefulness of the MR perfusion study of cervical spinal cord by Gd bolus injection by using PRESTO (Principles of Echo Shifting with a Train of Observations) pulse sequence.

Introduction
It has been very difficult to evaluate the perfusion of the spinal cord, because the spinal cord is not only a thin and slender object but also circumscribed by thick bones. When we use an EPI pulse sequences or gradient echo pulse sequences with long TE, as are usually used to evaluated the brain perfusion, the susceptibility artifacts distort the geometry and change the intensity of the spinal cord. PRESTO pulse sequence (1) has short TE echo train and also has a short TR. However, the actual TE is longer than TR, and is very sensitive to T2* effect. Due to this short EPI echo train however, image quality is superior and image distortion is minimal, and can maintain during the larger T2* changes induced by the bolus Gd-DTPA passage. So, it is suitable for perfusion studies, especially for the cervical spinal cord perfusion studies.

Methods
6 studies out of 3 patients of spinal cord perfusion were examined by PRESTO pulse sequence with TR 17.6 ms and TE 8.5 ms. Each slice thickness is 4 mm. Three simultaneous slices with 64 dynamic phases were taken in approximately 2 minutes. Fifteen ml of Gd-DTPA were injected by automatic power injectors at the rate of 3 ml per second via a antecubital vein. The contrast materials were flashed with 20 ml of saline, shortly after the injection of the contrast. Examinations were performed with GYROSCAN NT (model PT6000, 1.5T Philips). Data were analyzed in UNIX based workstation (EasyVision) by a built in software for the analysis of the brain perfusion study.

Results
Clear signal intensity dip was observed within the spinal cord, approximately 30 seconds after the injection of Gd. The susceptibility artifacts and image distortions were small for calculating the time intensity curves. The delay of the time to peak descended from cranial portion to caudal and anterior to posterior at the cervical spinal cord. These findings were thought to be the reflection of anatomical and circulatory feature of anterior cervical spinal cord. Fig1 shows the time intensity curve of a cervical spinal cord.

Discussion
The brain perfusion study is well established method for evaluating the perfusion of brain and usually used by EPI pulse sequences. However, due to the distortion of the skull base and posterior fossa, the perfusion of temporal lobe and posterior fossa is not reliable. PRESTO pulse sequence has a capability of 3D acquisition and is very sensitive to T2* with less image distortion. This pulse sequence is suitable for not only brain perfusion but also for cerebral spinal cord perfusion studies.

References
(1) An echo-shifted gradient-echo MRI method for efficient diffusion weighting.
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