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NMR Imaging of the Spine

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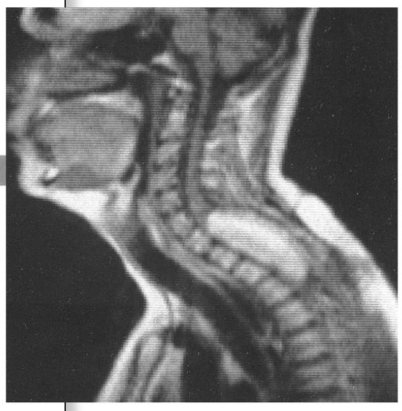
The usefulness of nuclear magnetic resonance (NMR) images in the evaluation of spinal disorders below the craniocervical junction was studied. Six normal subjects and 41 patients with various spinal abnormalities were examined. NMR proved capable of demonstrating important normal and pathologic anatomic structures; it was useful in the evaluation of syringohydromyelia and cystic spinal cord tumors, and the bright signal intensity of lipoma was quite impressive. In the evaluation of herniated disk, NMR images offered a new perspective by visualizing abnormal degradation of the signal intensity of the nucleus pulposus itself. NMR images were least valuable in the evaluation of spondylosis and spinal stenosis. Although NMR imaging of the spine is still in a very early developmental stage, the absence of both ionizing radiation and risks associated with contrast material makes it especially attractive as a new diagnostic method. This limited experience with currently available equipment suggests that, with technical refinement, the efficacy of NMR of the spine will increase.



Nuclear magnetic resonance (NMR) holds great promise as an imaging method, with its high theoretical limits in image detail and very low attendant risks. Clinical experience in the evaluation of the central nervous system, particularly the brain, is rapidly accumulating [1–5]. However, the normal anatomic features of the spine have not been established thus far with NMR. We summarize initial NMR studies of spinal anatomy in normal subjects at our institution and present NMR findings in a spectrum of spinal pathology.

Subjects and Methods

During a 5-month period, six normal subjects and 41 patients with various spinal abnormalities underwent NMR examinations at Case Western Reserve University/University Hospitals of Cleveland. Normal adult volunteers included four men and two women with a mean age of 31 years. To delineate the normal morphologic images of the spine and its related structures, the entire spinal column of each normal subject was studied in a supine position. NMR studies were also performed on 41 patients (20 men and 21 women; age range, 12–77 years; mean age, 37 years) who had a confirmed diagnosis on the basis of clinical findings and/or preceding radiologic studies, including myelography and computed tomography (CT). Written informed consent was obtained from all participants.

Various radiofrequency pulse sequences were used to obtain the NMR images, including saturation-recovery (SR), inversion-recovery (IR), and T_2-weighted spin-echo (SE) pulse sequences. The principles describing these sequences and the technique of NMR imaging have been described [4–6]. The NMR imaging system that we currently use is a Cryogenic Superconducting Magnet (Teslacon, Technicare Corp., Solon, OH) with a 100 cm bore, operating at 3.0 kG. The NMR scan was generated using a two-dimensional Fourier transform technique with 128 phase-encoding data lines. The data acquisition time varies depending on the pulse sequences used. The SR technique (0.5 sec sequence interval, 30 msec echo delay) requires 2.3 min; the IR technique (1.5 sec sequence interval, 30 msec echo delay and 450 msec inversion time), 6.7 min; and the T_2-weighted SE technique (1.0 sec sequence interval, 60 msec echo delay), 4.5 min. The slice thickness is about 10 mm.

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Limitations in the Interpretation of Intravenous Carotid Digital Subtraction Angiography

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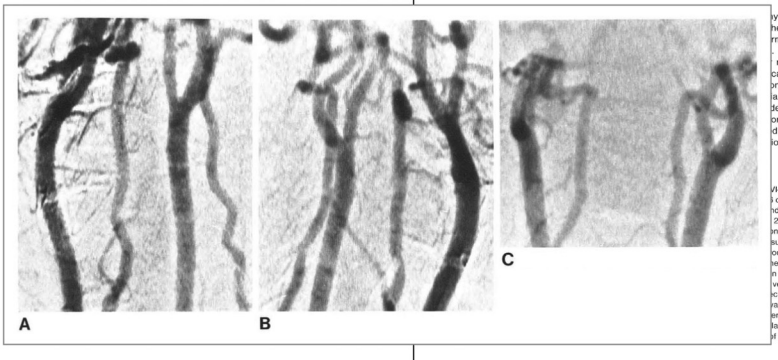
To evaluate the limitations of intravenous carotid digital subtraction angiography (DSA) in the diagnosis of carotid disease, studies of 130 patients were reviewed. Factors that resulted in a nondiagnostic study included: (1) misregistration larynx artifact overlying the carotid bifurcation; (2) external carotid or vertebral artery overlying the internal carotid artery; and (3) poor arterial contrast density secondary to poor cardiac function. As a result of these limitations, the ideal of adequate demonstration of both carotid bifurcations in two opposite oblique projections or an oblique and anteroposterior projection was achieved in only 34 patients (26%). Of 126 carotid bifurcations that were seen adequately in two or more different projections, 19 (15%) showed an abnormality in one projection but appeared normal in another. These abnormalities would not have been detected had the vessel been visualized only in the spuriously normal-appearing projection. These and other limitations of intravenous DSA, such as contrast load and morbidity, are discussed.



y (DSA) has become popular for screening
he brachiocephalic vessels [1–5]. Avoidance of
rmance on an outpatient basis account for the
. Recent reports have indicated that clinical
nonoperative treatment can be made on the
cases [1]. Furthermore, it has been stated that
onal aortic arch angiography [2]. However, we
a are applied, carotid DSA studies may be
dence not warranted by the quality or complete-
oreover, although the incidence of significant
dure is not without risk and the associated
ion.

VH-I, Lot 2, was used with a 0.7 mm focal spot and 6,
cm) image intensifier modes. Exposure factors were
d were generally 100–200 mA and 65–75 kVp. The
256 × 8 matrix. Imaging was performed using the
ne frame/sec, averaging eight frames.
sume about 1 L of fluid beginning the previous night
ocedure. With the Seldinger technique, a 5.0 French
eter was placed in the superior vena cava via an
n whom an arm vein could not be catheterized, the
vena cava via a femoral vein. For each projection, 40
cted at 20 ml/sec. Exposures were initiated 4–5 sec
aluation consisted of four projections: 45°–55° right
erior oblique (LPO) of neck; 55° RPO of aortic arch;
lation. Additional steeper oblique or anteroposterior
t interest were obtained frequently. Postprocessing