Magnetic resonance evaluation of spinal dysraphism in children

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Abstract. Magnetic resonance (MR) imaging of the spine was performed as the initial imaging technique in 20 children when spinal dysraphism was suspected clinically and plain radiographs showed spina bifida. The correlation with surgical findings indicated that MR provided accurate information preoperatively in all the cases. Some unusual observations in cases with spina bifida cystica and occulta are discussed. It is concluded that plain radiograph and MR complete the preoperative radiologic evaluation of cases with spinal dysraphism.

Key words: Magnetic resonance imaging – Spinal dysraphism – Spinal cord abnormalities – Pediatric spinal cord

Spinal dysraphism designates the group of congenital abnormalities of the spine that involve, in part, imperfect fusion of midline mesenchymal, bony, and neural structures [13, 18]. The radiographic evaluation of pediatric spina bifida traditionally includes plain radiographs, myelography, and computed tomography (CT) [8, 13, 18]. These modalities are, however, associated with the risk of intrathecal contrast material and radiation exposure, and they require general anaesthesia in most patients [1, 2, 16]. Clinical experience with magnetic resonance (MR) in the diagnosis of spinal disorders is now well established [1–3, 6, 7, 10, 16]. Recently, MR has been prescribed as the initial diagnostic tool in the evaluation of spinal dysraphism due to its ability to perform multiplaner imaging and characterize the intraspinal contents without bony artefacts [1, 3, 10, 16].

The aim of this communication is to report some unusual and diverse MR findings of spinal dysraphism in children.

Patients and methods

Twenty children, ranging in age from 15 days to 14 years, with dysraphism were evaluated with MR. These children were referred for MR in order to evaluate spinal cord symptoms caused by the dysraphic condition. A plain radiograph of the spine was done in all cases prior to MR examination. Myelography and metrizamide CT were not performed because of their reported hazards and comparatively inferior resolution [1, 10, 16]. MR examinations were correlated with surgical findings in all cases.

MR was performed with a 1.5-T super-conducting MR scanner (Magnetom, Siemens). The spin-echo technique was used with an echo time (TE) of 28 ms and repetition time (TR) ranging from 500 to 700 ms, to obtain T1 weighted images. The slice thickness was 5 mm with no interslice interval. The images were obtained in sagittal, coronal, and axial planes on a 256 x 512 matrix. The upper cervical spine in sagittal plane was routinely studied in all these cases to look for the position and shape of the cerebellar tonsils and brain stem. When T2 weighted images were required, a double echo pulse sequence with a TE of 28 and 84 ms and a TR of 2800 ms was used. In patients younger than 5 years of age, routine sedation with oral chloral hydrate syrup, 50 mg/kg body weight, was given 30 min prior to the scan.

Results

The MR findings of the 20 patients are summarized in Table 1. MR examination in these cases included five cases of spina bifida cystica (SBC). Of the five children with SBC, three had cervical meningocele and two had lumbar meningocele. In all three cases with cervical meningocele, the spinal cord was tethered posteriorly by a thick band, biopsy material from this revealed fibrous tissue (Fig. 1). One case had Chiari I anomaly and another showed Chiari II anomaly with syringohydromyelia extending from the 2nd cervical to the 8th dorsal vertebrae. Of the two children with lumbar meningocele, one showed localized syrinx involving the 11th dorsal to the 1st lumbar vertebrae with a small septum partially dividing the cavity (Fig. 2). Tethered cord was seen in both the cases of lumbar meningocele.
### Table 1. Summary of cases

<table>
<thead>
<tr>
<th>Spinal dysraphism</th>
<th>Associated abnormalities</th>
<th>Meningocele</th>
<th>Syringohydromyelia</th>
<th>Band (fibrous)</th>
<th>Chiari malformation</th>
<th>Lipomyeloschisis</th>
<th>Diastematomyelia</th>
<th>Lipomas</th>
<th>Low conus&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spina bifida cystica (n = 5)</td>
<td></td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
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<td>8</td>
<td>6</td>
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<tr>
<td>Cervical (n = 3)</td>
<td></td>
<td>2</td>
<td>1</td>
<td>-</td>
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<td></td>
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<tr>
<td>Lumbar (n = 2)</td>
<td></td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td></td>
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<tr>
<td>Spina bifida occulta (n = 15)</td>
<td></td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dorsal (n = 2)</td>
<td></td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Dorsolumbar (n = 1)</td>
<td></td>
<td>-</td>
<td>3</td>
<td>-</td>
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<tr>
<td>Lumbar (n = 12)</td>
<td></td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
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<td>5</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

<sup>a</sup> Three cases with diastematomyelia had syringohydromyelia near the superior end of the split cord

<sup>b</sup> Five cases with diastematomyelia and all the cases with lipomyeloschisis also had low conus.

**Spina bifida occulta (SBO)**

MR correctly identified abnormal spinal cord morphology in all the 15 cases. Spina bifida involving the lumbar spine was seen in the majority (n = 12), followed by dorsal (n = 2) and dorsolumbar spine (n = 1).

**Tethered cord**

The spinal cord was considered tethered when ilium terminale was more than 1.5 mm thick and/or the conus was lower than the 2nd lumbar vertebral body [9]. Primary tethered cord was seen in two cases with lumbar spina bifida.

**Diastematomyelia**

Diastematomyelia was diagnosed when a split cord with dural penetration by a bony, cartilagenous or fibrous spur or merely a split cord with intact dural sleeves was seen [8]. There were eight cases with diastematomyelia. The bony septum was seen in three, fibrous septum in three, and splitting of cord without septum in the remaining two. The bony septum was identified as a continuation of bone marrow intensity with edges of the bone showing very low intensity on both T1 and T2 weighted images. The fibrous septum showed low intensity on both T1 and T2 weighted images. In these cases sagittal images showed some bands going from the posterior to the anterior part of the spine in the area that showed diastematomyelia on axial scan (Fig. 3). The axial scan was found to be ideal for demonstration of diastematomyelia, though the extent of the split cord could also be seen on coronal view. Three cases with diastematomyelia were associated with localized syringohydromyelia near the rostral end of the split cord (Fig. 3). Low conus was seen in five cases with diastematomyelia.

**Lipomyeloschisis**

Cord tethering to an intradural lipoma at the level of SBO was diagnosed as lipomyeloschisis [12]. This was seen in eight cases, seven of which had lumbar SBO. The conus was seen lying low in all the cases. The lipomatous tissue was seen extending upward and downward in-