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MRI EVALUATION OF SPINAL DYSRAPHISM WITH DEPICTION OF THE SPECTRUM OF MRI FINDINGS

Radio-Diagnosis

Dr. Eshita Yadav Junior Resident, Department of Radio-diagnosis, SRMS IMS, Bareilly

Dr. Sameer R. Verma Professor & HOD, Department of Radio-diagnosis. , SRMS IMS, Bareilly

Dr. Kalpana Pimoli Junior Resident, Department of Radio-diagnosis, SRMS IMS, Bareilly

Dr. Raghav Soni Junior Resident, Department of Radio-diagnosis, SRMS IMS, Bareilly

ABSTRACT

Aims and objectives- MR evaluation of spinal dysraphism with depiction of the spectrum of MRI findings in spinal dysraphism **Materials and Methods-** This hospital based study was done over a period of two years and included 22 patients diagnosed with spinal dysraphism on MRI at a tertiary care teaching hospital in northern Uttar Pradesh. MRI examinations were carried out on MRI Magnetom Skyra 3.0 Tesla and MRI Sampra 1.5 Tesla and MRI findings in the various disorders of spinal dysraphism were recorded. **Results-** A total of 22 patients including 8(36%) females and 14(64%) males with age range from 1st day of life to 10 years were diagnosed as having spinal dysraphism with its associated manifestations. There were 8(36%) cases of open and 14 (64%) cases of close spinal dysraphism. Spectrum of MRI findings included tethered cord (45%), myelomeningocele (36%), diastematomyelia (23%), syrinx (18%), tonsillar herniation (18%), hydrocephalus(14%), lipomyelocoele (9%), lipomeningomyelocoele (9%), meningocoele (9%), intradural lipoma (9%), corpus callosal dysgenesis (5%) myelocystocoele (5%) and caudal agenesis (5%). **Conclusion-** MRI is the investigation of choice for the detection of spinal dysraphism and the associated CNS abnormalities.

KEYWORDS

Spinal Dysraphism, Neural tube defects, MRI

INTRODUCTION

Spinal dysraphism is an umbrella term that depicts any irregularity of the spinal cord, cauda equina or overlying tissues, for example, vertebrae, muscles and skin. The sensory system variation from the norm might have related mesenchymal or dermal changes.[1,2,3] Neural tube defects are the second most common type of birth anomaly after congenital heart disease [4]. SDs are a subtype of neural tube defects, with an estimated prevalence of about one to three per 1000 live births[5]. The lumbosacral spine is the most common site, involved in 90% of cases, followed by the thoracic spine (6%–8%) and cervical spine (2%–4%) [6]. Spinal development have been summarized in three embryologic stages [7,8]. The first stage is gastrulation and it occurs in the second or third week of embryonic development. Gastrulation is the conversion of the embryonic disk from a bilaminar disk to a trilaminar disk consisting of ectoderm, mesoderm, and endoderm. The second stage in spinal development is primary neurulation (weeks 3–4) in which the notochord and overlying ectoderm interact to form the neural plate. The neural plate bends and folds to form the neural tube, which eventually closes in both the directions in a zipperlike manner. The final stage of spinal development is secondary neurulation (weeks 5–6). During this stage, a secondary neural tube is formed by the caudal cell mass. The secondary neural tube is initially solid subsequently undergoing cavitation, eventually forming the tip of the conus medullaris and filum terminale by a process called retrogressive differentiation. Abnormalities in any of the above steps can lead to spine or spinal cord malformations.

Spinal dysraphisms can be comprehensively classified into open and closed types[9,10] Open dysraphism, in which there is introduction of irregular sensory tissues through a skin defect , and close dysraphism, in which skin covers completely and in a continuous manner to the underlying spinal abnormality[9] Open spinal dysraphisms includes myelomeningocele and other uncommon variations, for example, myelocele and hemimyelomeningcoele. Close spinal dysraphisms are further divided in relationship with low-back subcutaneous masses. Close spinal dysraphisms with mass are shown by lipomyelocele, lipomyelomeningocele, meningocele, and myelocystocele. Close spinal dysraphisms without mass include basic dysraphic states (tight filum terminale, filar and intradural lipomas, persistent terminal ventricle, and dermal sinuses) and complex dysraphic states.

Complex dysraphic states contains deformities of midline notochordal combination (essentially represented by diastematomyelia) and defects of segmental notochordal arrangement (represented by caudal agenesis and spinal segmental dysgenesis) Magnetic resonance imaging is the investigation of choice for visualising the whole anatomy of the pediatric spine. Ultrasound can be used as a valuable screening method before ossification of the posterior elements of the spine, however there is still need for MRI imaging in cases, either of abnormal sonogram or babies with a normal ultrasound but having an associated neurological abnormality.[11] This study was done for MR evaluation of spinal dysraphism with depiction of the spectrum of MRI findings in spinal dysraphism in a hospital based setting.

MATERIALS AND METHODS

This study was done over a period of two years and included 22 patients diagnosed with spinal dysraphism on MRI at a tertiary care teaching hospital in northern Uttar Pradesh. MRI examinations were carried out on MRI Magnetom Skyra 3.0 Tesla and MRI Sampra 1.5 Tesla and MRI findings in the various disorders of spinal dysraphism were recorded.

RESULTS

A total of 22 patients including 8(40%) females and 14(60%) males with age range from 1st day of life to 10 years were diagnosed as having spinal dysraphism with its associated manifestations.

Table 1. Type of spinal dysraphism on MRI

PATIENTS	OPEN SPINAL DYSRAPHISM	CLOSED SPINAL DYSRAPHISM
MALE	5	9
FEMALE	3	5

Lower lumbar and sacral regions of the spine were most commonly affected in 19 cases (86.4%) while dorsal spine was affected in two cases and cervical spine in one case.

Table 2: Spectrum of MRI findings

Type	Case number	Percentage (%)
Tethered cord	10	45
Myelomeningocoele	8	36
Diastometomyelia	5	23
Syrinx	4	18
Tonsillar herniation	4	18
Hydrocephalus	3	14
Lipomyelocoele	2	9
Lipomeningomyelocoele	2	9
Meningocoele	2	9
Intradural lipoma	2	9
Corpus callosum agenesis	1	5
Myelocystocoele	1	5
Caudal agenesis	1	5

DISCUSSION

The estimated incidence of spinal dysraphism is about 1-3/1000 live births. The prevalence of spinal dysraphism has been in decline the world over in the last few decades due to the better nutrition for women, folic acid supplementation, improved antenatal care and high-resolution ultrasound for prenatal screening and biochemical markers.[17]

In this study male patients were more common than female patients with male to female ratio of 1.5:1. This is in contradiction to the study by Synese et al which showed female predominance[18] and is in agreement with another Indian study by Kumar and Singh showing male predominance.[19]

The cases of closed spinal dysraphism outnumbered that of open spinal dysraphism in this study which is in disagreement with the study by Kumar and Singh[19].

The most common region affected was lumbar region followed by sacral region which is in agreement with the established literature. [18-20]

Caudal agenesis was found in 5% of the cases in our study while study conducted by Rossi et al [120] shows its incidence as 11.3% and 17.6% in study conducted by Nishtar T et al[21].

In our study 7 patients out of the total 22 patients were infants, all of whom presented with soft tissues swelling in lumbosacral region and were diagnosed as having spinal dysraphism by MRI of the lumbosacral spine. These infants were suffering from a spectrum of spinal dysraphic state, ranging from spina bifida to split cord syndrome (diastematomyelia).

The incidence of diastematomyelia in our study was 23% while study done by Mc Comb et al[22] shows its incidence to be 20-40% of the 15 cases and study done by Nishtar T et all[21] to be 41.1%.

MRI is a noninvasive investigation and radiation is not involved, rendering it to be the investigation of the choice for the detection of occult spinal dysraphism. As MRI is a safe and risk free procedure with its excellent diagnostic value, it is considered as the first line investigation for the diagnosis spinal dysraphic states.[23,24]

CONCLUSION

MRI is the considered as the investigation of choice for the detection of occult spinal dysraphism and its associated CNS abnormalities.

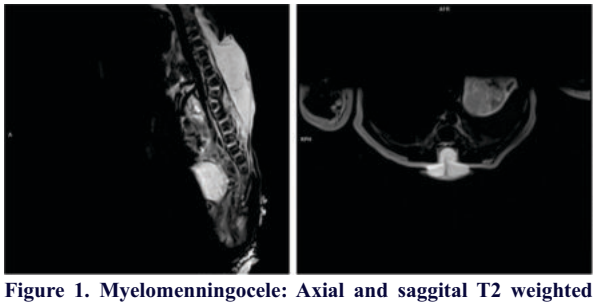

Figure 1. Myelomenningocele: Axial and saggital T2 weighted images show a large spinal dysraphism not covered by skin surface with herniation of the meninges and neural tissue adhered to the posterior wall forming the neural placode.

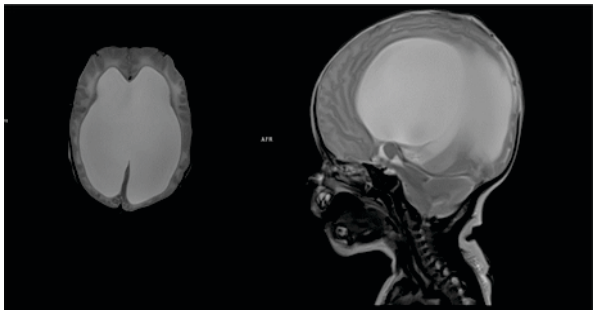

Figure 2 : There is gross dilation of both lateral ventricle with herniation of the cerebellar tonsil and small posterior fossa. Spectrum of findings on chiari II malformation most commonly associated with myelomeningocoele

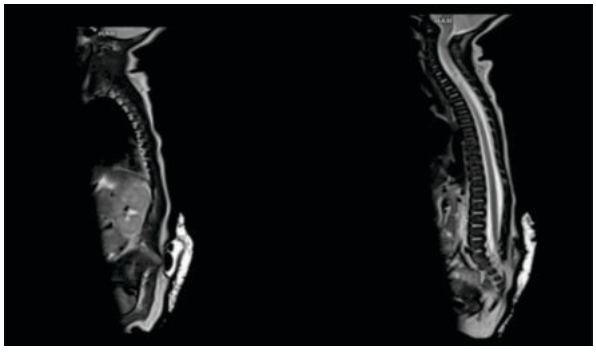

Figure 3: Spinal cord is extending upto the level of L5 vertebrae with cord adhered to posterior dura s/o tethered cord.

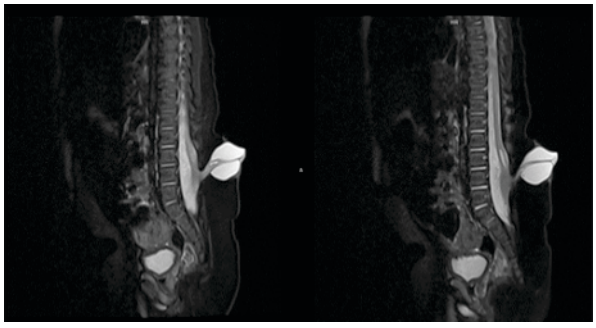

Figure 4 : Myelocystocele Small defect noted in posterior element with herniation of neural placode through it and is seen reaching upto the skin in the posterior midline with associated well defined hyperintense lesion in the subcutaneous plane with stretched but intact overlying skin. Low lying tethered cord noted with conus and presence of syringohydromyelia

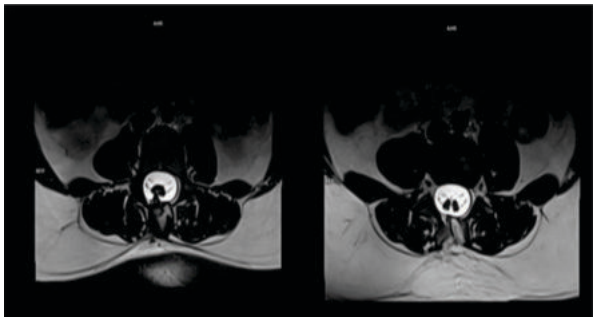

Figure 5: Diastematomyelia T2 weighted axial sections show bifurcation of the spinal cord into two hemicords both surrounded by same dural sac

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