Original Research Article

Congenital Spinal Anomalies – Role of X-rays and MRI

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Abstract

Background: Spine is a longitudinal structure, and precise location of the level of a lesion using clinical examination can be difficult. X-Ray is the primary modality of choice; they demonstrate bony anomalies better in less time and are cost effective, while MRI of spine shows the anatomy of the vertebrae that makes up the spine, as well as the discs, spinal cord and the intervertebral foramina through which the nerves pass. It also allows us to differentiate between healthy tissue and diseased tissue.

Aim and objectives: The primary aim of the study was to evaluate the role of MRI and X-ray in congenital spinal anomalies. The secondary objectives were: (a) study the appearance of various congenital spinal diseases on MRI and X-ray; (b) usefulness of MRI and X-ray in determining the type of congenital spinal anomalies and (c) to compare the findings of MRI and X-ray.

Materials and methods: The present study was conducted at Department of Radiodiagnosis, SBKS Medical Institute and Research Centre and Dhiraj General Hospital, Vadodara Gujarat, during the study period April 2015 to September 2016. Thirty-five patients with confirmed congenital spinal lesions either during the enrollment or prior were included in the study. Patients with already cured spinal lesions were excluded from the study.

Results: There were 35 patients with congenital spinal lesions. Of these, 51.42% and 48.57% were females with the age group of patients ranging from 1-day old neonate to 65 years. Majority of them were less than 20 years age group followed by 21-30 and 31-40 years of age group, whereas there were only 14.28% patients with age more than 40 years. Lumbar spine was the most commonly affected spine region in pediatric age group. Maximum numbers of patients were of open spinal dysraphism (31.41%) and Chiari malformation (25.70%).

Conclusion: MRI by virtue of non-invasiveness, lack of radiation hazard and its ability to demonstrate structural changes and ability to image the cord directly, makes it an investigation of choice for spine and spinal cord pathologies.

Key words

MRI, X-ray, Congenital spinal anomalies, Deformity.

Introduction

A medical condition that is present at or before the birth of a child is known case a congenital disorder. These birth defects can be acquired either during the fetal development or from the genetic makeup of the parents.

Spine is a longitudinal structure, and precise location of the level of a lesion from clinical examination can be difficult. A variety of diseases affect the osseous and soft tissue structures of the spine. Accurate diagnosis is often challenging, although a number of imaging methods are available for this purpose [1].

The vertebral column and spinal cord are closely related from an anatomical and developmental perspective. During the first 8 weeks of development, bony elements of the spine form in coordination with the in folding and closing of the neural tube [2]. Therefore, congenital malformations of the bony structure of the vertebral column, particularly those associated with scoliosis and kyphosis, are often accompanied by abnormalities of the spinal cord [3].

Congenital deformities of the spine are caused by anomalous vertebral development in the embryo. Minor malformations of the spine are seldom apparent and often are identified only on routine chest films. The more severe congenital malformations that result in progressive scoliosis are even less common than are idiopathic scoliosis. Congenital anomalies of the spine may be simple and benign, causing no spinal deformity, or they may be complex, producing severe spinal deformity or even cor pulmonale or paraplegia.

MRI is a non-invasive diagnostic procedure, which produces detailed pictures of the organs, soft tissue, bone and virtually all other internal body structures using magnetic field, radiofrequency pulses and a computer. Unlike X-rays, MRI do not use ionizing radiations [4].

X-rays are capable of showing structural vertebral anomalies such as hemivertebra, butterfly vertebra, or incomplete fusion of posterior elements; it does not allow imaging of the spinal cord. Radiographs of the vertebrae provide information for early evaluation of infants born with myelomeningocele. Congenital spinal deformities need to be tracked closely. The radiation dose from plain radiographs of the spine is a major limiting factor in examining infants, children, and young, fertile women. Plain radiography of the lower spine delivers a high dose to the gonads, particularly in female patients. Plain images may be sufficient for assessing myelomeningocele before early surgery to assess the extent of the bony defect, though this is not always required [5].

The present study was taken up to find out the role of MRI and X-ray in identification of various congenital spinal diseases, determining their type and thus help the treating physician in making an accurate treatment plan.

Materials and methods

The study was conducted in the Department of Radiodiagnosis, SBSK Medical Institute and Research Centre and Dhiraj General Hospital, Vadodara, Gujarat from April 2015 to September 2016. It was a prospective, observational study. All patients presenting for examination of MRI during the study period were included.

Patients of any age and gender, who were referred to Department of Radiodiagnosis for X-ray and MRI spine investigations and found to have positive findings; already diagnosed cases of congenital spinal lesions and requiring follow-up radiological investigations and those willing for participation in the study were included. While patients with past history of spinal lesions who were already cured and those not willing for participation in the study were excluded.

X-ray machines used in the study were Siemens 600 mA, 500 mA and 300 mA. CR system used was Kodak and MRI machine used was Philips 1.5 Tesla.

After obtaining ethics committee clearance the study was initiated. Also, before enrolling any patient in the study, a voluntary written informed consent was obtained.

First the X-ray of the spine was done in various planes depending upon the involvement of the cervical, dorsal or lumbo-sacral spine. The radiation dose was kept in pediatric patients. Mostly the anterior-posterior and lateral views were performed. Oblique views were reserved for especial cases. The MRI scans were performed on a 1.5 T Philips Scanner using T1 Weighted spin echo (T1W) sequence in the axial and the sagittal plane, the T2 weighted fast spine echo (T2W) sequence in the axial and sagittal plane and the Short tau inversion recovery (STIR) sequence in the coronal plane. If required, then other MRI sequences were performed depending upon the case.
A customized proforma was designed for the purpose of the study for collecting the information. Patients had to make the payment for the diagnostic modality as per the laid down schedule of charges of the institution, while no additional test / procedure was performed for the specific requirement of the study. In all a total of 35 patients were enrolled in the study.

Results

Majority of the patients i.e. 22.85% were neonates (age < 28 days) and children (age 1-10 years). 11.42% patients were in the age group 1 month to 1 year; 20% were in the age group 11-20 years; 14.28% were in the age group 41-70 years, 5.71% were in the age group 31-40 years and 2.85% were in the age group 21-30 years.

There was a slight male preponderance in our study (Male 51.42% versus Females 48.57%).

The most common presenting clinical symptoms was swelling over back seen in 31.42% patients, followed by headache seen in 20% patients, backache and pain in neck seen in 14.28% patients each, stiffness in 11.42% patients, tingling and numbness in 8.57% patients, weakness in 8.57% patients, scoliotic deformity and urinary incontinence seen in 5.71% patients each, while in 8.57% patients other symptoms were seen (**Table – 1**).

Table - 1: Presenting clinical features.

Clinical features	Number	Percentage
Swelling over back	11	31.42%
Headache	7	20.00%
Backache	5	14.28%
Pain in neck	5	14.28%
Stiffness	4	11.42%
Tingling & numbness	3	8.57%
Weakness	3	8.57%
Scoliotic deformity	2	5.71%
Urinary incontinence	2	5.71%
Other symptoms	3	8.57%

Lumbosacral was the most common region involvement seen in our study (42.85%), followed by cervical in 31.42% and dorsal in 25.71% patients (**Table – 2**).

Table - 2: Region of involvement.

Region	Number	Percentage
Cervical	11	31.42
Dorsal	9	25.71%
Lumbosacral	15	42.85%
Total	35	100%

Majority of the patients were having Klippel Feil syndrome seen in 17.40%, followed by Chiari 1 malformation in 14.28%, meningocele, meningo-myelocele and Chiari 2 malformation seen in 11.42% each, lipomyelomeningocele, diastematomyelia, hemivertebrae seen in 8.57% each, neurofibroma, spina bifida occluta and block vertebrae seen in 2.85% patient each (**Table – 3**).

Table - 3: Final diagnosis.

Final Diagnosis	Number	%
Klippel Feil syndrome	6	17.40%
Chiari 1 malformation	5	14.28%
Meningocele	4	11.42%
Meningomyelocele	4	11.42%
Chiari 2 malformation	4	11.42%
Lipomyelomeningocele	3	8.57%
Diastematomyelia	3	8.57%
Hemivertebrae	3	8.57%
Neurofibroma	1	2.85%
Spina bifida occulta	1	2.85%
Block vertebrae	1	2.85%
Total	35	100%

Myelomeningocele was most the common spinal cord pathology seen in our study i.e. in 31.43% patients, other spinal cord pathologies seen were tethered in 28.57% patients, syrinx in 14.29% patients and diastematomyelia in 8.57% patients while 17.14% patients had no spinal cord involvement.

Bony involvement was seen in 27 patients, of which 11 patients had vertebral body anomalies and 17 had posterior element anomalies.

Spinal cord involvement is seen in 20 patients, however, extraspinal soft tissue involvement is seen in 16 patients.

Anomalies diagnosed were grouped in age groups: Less than 1 year, 1 year to 25 years and more than 26 years. In the age group less than 1 year, meningomyelocele was the commonest seen in 5 patients, followed by Chiari malformation seen in 3 patients. In the age group 1 year to 25 years, block vertebrae were commonest seen in 4 patients, followed by lipomyelomeningocele and diastematomyelia seen in 3 patients each while in the age group more than 26 years, Chiari malformation was commonest seen in 5 patients, and Klippel Feil syndrome seen in 3 patients (**Table – 4**).

Table - 4: Distribution of anomalies in various age groups.

Age group	Anomaly diagnosed	No. of Patients
Less than 1 year	Spina bifida occulta	1
	Hemivertebra	1
	Meningomyelocele	5
	Chiari malformation	3
	Block vertebrae	1
1 year to 25 years	Lipomyelomeningocele	3
	Diastematomyelia	3
	Block vertebrae	4
	Congenital scoliosis	2
	Hemivertebrae	2
	Chiari malformation	1
	Neurofibroma	1
More than 26 years	Klippel feil	3
	Chiari malformation	5

Discussion

Disabato JA, et al. [6] concluded that the actual spinal deformity may not be obvious at birth but progresses in proportion to spinal growth resulting in unbalanced growth of spine. Minor deformities may seldom be apparent and may be noted during periods of rapid growth (first 5 years of life) and again at adolescence, later in life as they progress on a routine radiograph workup of an unrelated problem.

McMaster, et al. [7] found that 11% of congenital spinal anomalies were non-progressive, 14% were slightly progressive and remaining 75% were significantly progressive. Although vertebral deformities are present at birth, clinical deformities often do not become apparent until curve progression occurs during growth spurt. These patients can present with

complaints related to degeneration resulting from the abnormal biomechanics related to deformity.

In a similar study by Lemire RJ, et al. [8] regarding "sex ratio in congenital malformations of the central nervous system" concluded there was no sex preponderance in their study. Male: female ratio was about 1:1 and also noted no significant difference.

Conclusion

MRI by virtue of non-invasiveness, lack of radiation hazard and its ability to demonstrate structural changes and ability to image the cord directly, makes it an investigation of choice for spine and spinal cord pathologies.

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