Evaluation of congenital and developmental spinal anomalies with MRI and conventional radiology X-RAY

[1]Dr. Vishal Bhardava, [2]Dr. Tamanna Gupta, [3]Dr. Jasmine Singh

[1]Professor, Department of Radiodiagnosis, Smt. B.K. Shah Medical Institute and Research Centre, Sumandeep Vidyapeeth University, Piparia Waghodia, Vadodara, Gujarat, India

[2,3]Resident, Department of Radiodiagnosis, Smt. B.K. Shah Medical Institute and Research Centre, Sumandeep Vidyapeeth University, Piparia Waghodia, Vadodara, Gujarat, India

Corresponding Author: Dr. Jasmine Singh

Abstract

Aim: The purpose of this study was to evaluate the role of MRI and X-RAY in congenital spinal anomalies.

Methods: This study aimed at diagnosing up cases of congenital spinal anomalies in the department of Radio diagnosis of SBKS Medical Institute & Research Centre and Dhiraj general hospital. The study was performed using X-rays and MRI.

Results: Most common age group in my study was neonatal age group (<28 days) & children age group (1-10 years), with same incidence rate of 22.85%, when congenital spinal anomalies were studied and diagnosed. The male: female ratio was about 1:1 and no significant difference noted. In this study the most common spinal region involved in congenital anomalies is lumbosacral, out of 35 cases, 15 patients had lesion in lumbar & sacral spine (42.85%), followed by cervical spine 11 cases (31.42%), then dorsal spine 9 cases (26%). Most common congenital spine disease encountered in this study was meningocele, meningomyelocele, lipomeningomyelocele 4 cases (11.42%), 4 cases (11.42%). Total no. of patients in which spinal cord anomalies detected are 29 out of 35 patients (82%), 11 patients having myelomeningocele, 10 patients diagnosed as tethered cord, 5 patients diagnosed syrinx, 11 patients 3 patients diagnosed diastematomyelia and 6 patients have no cord involvement.

Conclusion: This study showed the proportion of patients suffering from various types of congenital spinal anomalies. It also showed the effectiveness of the imaging and clinical presentation in making the correct diagnosis. In many patients clinical diagnosis is usually present but imaging reinforces the diagnosis in many cases. So, MRI& X RAY imaging plays an important role in early diagnosis and prompt treatment of patients with these disorders.

Keywords: Congenital spinal deformity, scoliosis, MRI, spinal cord, X-ray

Introduction

A congenital disorder is a medical condition that is present at or before birth. 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. The more severe congenital malformations that result in progressive scoliosis are even less common than are idiopathic scolioses. 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 corpulmonale or paraplegia.

"Xrays may show 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. 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]

MRI is a non-invasive investigative procedure. It uses a powerful magnetic field, radiofrequency pulses and a computer to produce detailed pictures of organs, soft tissue, bone and virtually all other internal body structures. The images can then be examined on a computer monitor, printed or copied to CD. MRI does not use ionizing radiations (X-rays).[4]

Hence the purpose of this study was to evaluate the role of MRI and X-RAY in congenital spinal anomalies.

Materials and Methods

This study aimed at diagnosing up cases of congenital spinal anomalies in the department of Radio diagnosis of SBKS Medical Institute & Research Centre and Dhiraj general hospital. The study was performed using X-rays and MRI.

Inclusion criteria

1. Only those patients who are willing to participate in study will be included.
2. Patients referred to the radiology department for XRAY & MRI spine investigation, and found to have positive findings, will be included in this study.
3. Already diagnosed cases of congenital spinal lesions & which need follow up radiological investigations and are referred to our radiology department will be included in study.

Exclusion criteria

Patients presenting to radiology department having spinal lesions in past and 7lare cured completely will be excluded from the study.

Radiographs were evaluated for bony vertebral abnormalities, and MRI images were then reviewed for anomalies of the spinal cord and meninges and for bony anomalies missed on plain radiographs. Radiology reports, patient medical records, and CT were used to establish the diagnosis.

Statistical Analysis

Chi-squared analysis was performed to compare groups for all categorical variables (spinal level, complexity of malformation, malformations of segmentation and/or formation, associated syndromes, and gender) and independent t tests were used to compare groups for continuous variables (number of abnormal vertebra). The level of significance was set a priori at p\0.05.

Results

Table 1: Demographic data

Age Group (Years)	Number of Patients	Total (%)
<28 days	8	22.85%
1 month to 1yr	4	11.42%
1 yr to 10yr	8	22.85%
11yr to 20yr	7	20.00%
21yr to 30yr	1	2.85%
31yr to 40yr	2	5.71%
41yr to 70yr	5	14.28%
Sex		
Male	18	51.42%
Female	17	48.57%
Region		
Cervical	11	31.42
Dorsal	9	25.71%
Lumbosacral	15	42.85%

Most common age group in my study was neonatal age group (<28days) & children age group (1-10years), with same incidence rate of 22.85%, when congenital spinal

anomalies were studied and diagnosed. It was followed by adolescent age group (11-20years), older adults age group (40-70 years), infants age group (upto 12 months), middle aged adults (31-40years) and adults age-group (21-30years) having an incidence rate of 20%, 14.28%, 11.42% & 2.85% respectively. In this study congenital spinal anomalies were little higher in males as compared to females. Out of 35 cases, there are 18 males & 17 females having an incidence rate of 51.42%& 48.57% respectively. The male: female ratio was about 1:1 and no significant difference noted. In this study the most common spinal region involved in congenital anomalies is lumbosacral, out of 35 cases, 15 patients had lesion in lumbar & sacral spine (42.85%), followed by cervical spine 11 cases (31.42%), then dorsal spine 9 cases (26%).

Table 2: Distribution according to final diagnosis and spinal cord pathology

Final Diagnosis	**No.**	**Percentage**
Meningocele	4	11.42%
Meningomyelocele	4	11.42%
Lipomyelomeningocele	3	8.57%
Chiari 1 Malformation	5	14.28%
Chiari 2 Malformation	4	11.42%
Diastematomyelia	3	8.57%
Klippel Feil Syndrome	6	17.40%
Hemivertebrae	3	8.57%
Neurofibroma	1	2.85%
Spina Bifida Occulta	1	2.85%
Block Vertebrae	1	2.85%
Pathology	**No.**	
Tethered	10	28.57%
Syrinx	5	14.28%
Diastematomyelia	3	8.57%
Myelomeningocele	11	31.42%
No Involvement of Cord	6	17.14%

Most common congenital spine disease encountered in this study was meningocele, meningomyelocele, lipomeningomyelocele 4 cases (11.42%), 4 cases (11.42%), 3 cases (8.57%) respectively followed by chiari malformation I & II, 5 cases (14.28%) & 4 cases (11.42%). 3 cases diagnosed of diastematomyeliaie (8.57%). Patients having only vertebral anomalies were 11 (31.42%). Total no. of patients in which spinal cord anomalies detected are 29 out of 35 patients (82%), 11 patients having myelomeningocele,10 patients diagnosed as tethered cord, 5 patients diagnosed syrinx, 11 patients 3 patients diagnosed diastematomyelia and 6 patients have no cord involvement.

Table 3: Distribution according to bony & soft tissue involvement

Vertebrae	**Body**	**11**
Soft Tissue	Poterior Elements	17
	Spinal Cord	20

	Extraspinal Soft Tissue	16

In this study out of 35 cases, 27 patients has vertebral involvement out of which 17 patients has detected posterior element anomalies and 11 patients has vertebral body anomalies. Out of 35 cases 26 patients have soft tissue involvement out of which 20 patients has diagnosed as spinal cord disease and 16 patients has diagnosed as extraspinal soft tissue involvement.

Table 4: Distribution according to symptoms

Clinical features	N	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%

In this study the most common clinical feature (symptoms) present is swelling over back 11 patients (31.42%), headache 7 (20%), backache 5 patients (14.28%), pain in neck 5 patients (14.28%), stiffness 4 patients (11.42%), tingling 7 Numbness present in 3 patients (8.57%), weakness in 3 patients (8.57%), 2 patients present with scoliotic deformity i.e. (5.71%), 2 patients have urinary incontinence (5.71%) and 3 patients have other complains (8.57%).

Table 5: Distribution according to disease profile in various age groups

Age Group	Anomaly Diagnosed	No of Patients
Less Than 1 Year	Spina bifida occulta	1
	Hemivertebra	1
	Meningomyelocoel	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	Klippelfeil	3
	Chiari malformation	5

In this study all patients are devided into 3 age groups and the disease which belongs to that age group is discussed, the 1st age group is less than 1year and the diseases that belongs to less than one yeart of age are meningomyelocele 5 cases, chiari malformations 3 cases, hemivertebrae& block vertebrae 1 case each. 2nd age group is between one to 25 years and the disease that mostly diagnosed in that age groups are diastematomyelia 3 cases, block vertebrae 4 cases, hemivertebrae 2 cases, lipomeningomyelocele 3 cases, chiari malformation 1 case, neurofibroma one case. 3rd group is more than 26 years and the cases diagnosed are 5 chiari malformation & three cases of klippel feil syndrome. In this study maximum 18 (45%) of the patients were in the age group of 0-10 years out of which 11 (27.5%) were males and 7 (17.5%) were females. Second most common age group was 20-30 years (22.5%). The males to females ratio for white matter diseases or lesions is almost equal. 53% (21) of the patients were female and 47% (19) of the patients were male. Most number of female patients presented in the first and third decade of life and maximum male patients presented in the first decade.

Discussion

The study was carried out at the Department of Radiology, Dhiraj General Hospital, Pipariya, Vadodara. A total of 35 patients were selected for the study between the time period of April 2015-Sept 2016.

Regarding sex distribution, congenital spinal anomalies were noted almost equally in both males and females and out of 35 cases, there were 18 males (51.42%) & 17 females (48.57%). The male: female ratio was about 1:1 and there is no significant difference noted. In a similar study by Ronald *et al*. [6] regarding "sex ratio in congenital malformations of the central nervous system" concluded there was no sex preponderance in there study. Male: female ratio was about 1:1 & no significant difference was noted. Considering the age of the patients, in my study of 35 patients the most common age group was of neonates (<28days) & children (1-10years), with same incidence rate of 22.85%. It was followed by age groups of adolescents (11-20years), older adults (40-70 years), infants (upto 12 months), middle aged adults (31-40years) and adults (21-30years) having an incidence rate of 20%, 14.28%, 11.42% & 2.85% respectively.

Most common congenital spinal diseases encountered in this study were meningocele, meningomyelocele and lipomeningomyelocele of which 4cases (11.42%), 4 cases (11.42%), 3 cases (8.57%) were noted respectively, followed by chiari malformation I & II, noted in 5 cases (14.28%) & 4 cases (11.42%) respectively. 3 cases (8.57%) of diastematomyelia were diagnosed. No of patients having only vertebral anomalies were 11 (31.42%) Considering bony and soft tissue involvement, 27 patients had vertebral involvement out of which 17 patients were detected with posterior element anomalies and 11 patients with vertebral body anomalies. 26 patients had soft tissue involvement, out of which 20 patients were diagnosed with spinal cord anomaly and 16 patients had extra-spinal soft tissue involvement.

During the study, most patients presented with signs and symptoms of swelling over back-11 patients (31.42%), headache-7 (20%), backache-5 patients (14.28%), pain in

neck-5 patients (14.28%), stiffness-4 patients (11.42%), tingling 7 Numbness present in-3 patients (8.57%), weakness in-3 patients (8.57%) and 2 patients (5.71%) presented with scoliotic deformity, 2 patients had urinary incontinence (5.71%) and 3 patients had other complains (8.57%). 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 presernt 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.

All patients were divided into 3 age groups and the disease which belongs to that age group is discussed, the 1st age group is less than 1year and the diseases that belong to less than one year of age are meningomyelocele 5 cases, chiari malformations 3 cases, hemivertebrae& block vertebrae 1 case each. 2nd age group is between one to 25 years and the disease that mostly diagnosed in that age groups are diastematomyelia 3 cases, block vertebrae 4 cases, hemivertebrae 2 cases, lipomeningomyelocele 3 cases, chiari malformation 1 case, neurofibroma one case. 3rd group is more than 26 years and the cases diagnosed are 5 chiari malformation & three cases of klippelfeil syndrome.

Hedequist & Emans *et al.* [8] concluded that the actual spinal deformity 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 progresses on a routine radiograph workup of an unrelated problem. recent guidelines for timing of MRI seem reasonable and include the presence of neurologic symptoms or signs such as bowel or bladder dysfunction, spasticity (upper motor neuron findings) or brainstem findings (swallowing difficulties), rapidly progressing spinal deformity (curvature), and for preoperative planning. [9, 10] Basu *et al*. found the highest incidence of spinal cord anomalies associated with spinal column deformities of the cervical and thoracic spines (37%), however, their study looked only at patients with hemivertebrae in the cervical, thoracic, and lumbar spine.[11] Lumbosacral transitional vertebrae (LSTVs), including sacralization of the lumbar and lumbarization of the sacrum, are congenital spinal anomalies, although due to their high prevalence some may consider them to be a variant of normal. [12, 13]

Conclusion

This study showed the proportion of patients suffering from various types of congenital spinal anomalies. It also showed the effectiveness of the imaging and clinical presentation in making the correct diagnosis. In many patients' clinical diagnosis is usually present but imaging reinforces the diagnosis in many cases. So, MRI& X RAY imaging plays an important role in early diagnosis and prompt treatment of patients with these disorders.

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