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EVALUATION OF SPINAL DYSRAPHISM USING CT

[1*]Dr. M. Praveen Kumar, [2]Dr. Alla Dinesh

[1]Associate Professor, Department of Radiodiagnosis, Surabhi Institute of Medical Sciences, Siddipet, Telangana State,

[2]Consultant Radiologist, Salas Medical Diagnostic Centre, Hyderabad

Corresponding Author: Dr. M. Praveen Kumar

Abstract

Background : Spinal dysraphism is a congenital disorder characterized by abnormal development of the spinal cord and vertebral column. CT (computed tomography) is a diagnostic imaging modality that can be used to evaluate spinal dysraphism.

Aim and Objective :To know about this study as first line imaging modality for evaluating spinal dysraphism. Material and Method : A observational prospective study was conducted comprises of 50 patients including age ranging from 1year to 30 years. The study was conducted for a period of one year. Patients included in the study after following inclusion and exclusion criteria and getting approval from institutional ethical committee.

Results : In open spinal dysraphism there were 13(34.21%) males and 28(65.79%) thus showing female predominance. 41(82%) were of open spinal dysraphism and 10 patients were with occult spinal dysraphism. In the open SD the 38(92.68%) cases of Myelomeningocele were most common lesion followed by Myelocele and meningocele. Most common lesion in occult SD was spinal lipomas among 4 patient out of 10 and among it Lipomyelomeningocele accounting for 75% of spinal lipomas followed by Lipomyelocele. In our study most common spinal curvature anomaly was scoliosis followed by Kyphosis and Lordosis.

Conclusion : CT can be a useful tool in the evaluation of spinal dysraphism, particularly for the assessment of bony structure, also it showed that multiplanar reformatted CT is an excellent imaging modality for characterization of vertebral segmentation defects, spinal curvature anomalies associated with SD.

Keywords : Spinal dysraphism, computed tomography, scoliosis, Myelomeningocele

Introduction

Spinal dysraphism is a congenital disorder characterized by abnormal development of the spinal cord and vertebral column. CT (computed tomography) is a diagnostic imaging modality that can be used to evaluate spinal dysraphism. CT scans produce detailed, cross-sectional images of the spine, which can help to identify the specific type and extent of the dysraphism.

Spinal dysraphism is the most common Neural tube defect in developing countries like India. The incidence varies from 0.5 to 11 per 1000 live births in different parts of our country, largely affecting the lower socioeconomic strata of the population.

There are several types of spinal dysraphism, including spina bifida, tethered spinal cord syndrome, and diastematomyelia. CT can be used to identify the location and severity of the dysraphism, as well as any associated abnormalities such as spinal cord tethering, bony deformities, or cysts.

In cases of spina bifida occulta, CT can be used to evaluate the vertebral column for any abnormalities, such as vertebral arch defects or abnormalities of the posterior elements. CT

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can also be useful in cases of meningocele or myelomeningocele to evaluate the size and location of the defect and to assess for any associated bony abnormalities or spinal cord tethering.

The use of CT in the evaluation of spinal dysraphism depends on the specific anomaly being evaluated. In general, CT is more useful for evaluating bony structures, such as the vertebral column and spinal canal, than for evaluating soft tissue structures, such as the spinal cord and nerve roots.

CT scans can provide valuable information for the diagnosis and management of spinal dysraphism. However, it is important to note that CT scans may not be the first-line imaging modality for evaluating spinal dysraphism, as MRI (magnetic resonance imaging) is often preferred due to its superior soft tissue contrast and lack of ionizing radiation. The choice of imaging modality will depend on the specific clinical situation and the preferences of the healthcare provider. Overall, CT can be a useful tool in the evaluation of spinal dysraphism, particularly for the assessment of bony structures and associated complications. Thus we have undertaken this study as first line imaging modality for evaluating spinal dysraphism.

Material and Method :

A observational prospective study was conducted comprises of 50 patients including age ranging from 1year to 30 years. The study was conducted for a period of one year. Patients included in the study after following inclusion and exclusion criteria and getting approval from institutional ethical committee. Patients visited to OPD, department of Radiology, Surbhi Institute of medical sciences, Siddipet and other outside referral were included in the study. clinically the most common cause for referral was swelling in the back predominantly Lumbosacral region. The other symptoms were sensory/motor deficit, bladder/ bowel disturbances, spinal curvature deformities, cutaneous features like dermal dimple, hypertrichosis, silky hair, dermal sinus and capillary hemangioma ect.

Inclusion Criteria

1. All cases of open spinal dysraphism.
2. Cases presenting with lumbosacral swelling.
3. Cases presenting with cutaneous stigmata like Dermal dimple, tuft of hair, Nevi, dermal sinus ect.
4. Cases showing vertebral anomalies in Plain radiograph.
5. Cases presenting with congenital scoliosis/ kyphoscoliosis/lordosis ect.
6. Cases presenting with bladder/bowel incontinence since childhood.
7. Cases presenting with motor or sensory deficit since childhood.

Exclusion Criteria

1. Treated cases.
2. Spinal tumours.

Method

CT Technique

All the examinations were performed on a GE Revolution ACT 16 slice

For interpretation the following Characteristics of Spinal dysraphism were studied and analysed in these patients.

1. Types

- ***Open Spinal Dysraphism***

Myelomeningocele, Myelocele, Meningocele.

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- ***Occult Spinal Dysraphism***

Spinal lipomas, Diastematomyelia, Dorsal dermal sinus, Tight filum terminale syndrome, Anterior sacral meningocele, Sacral agenesis.

2. CT Characteristics

- **Lesion Attenuation**

Fluid-Menigocele, Soft tissue with fluid-Menigomyelocele, Soft tissue-Myelocele, Fat with soft tissue-Lipomyelocele, Fat with soft tissue and fluid-Lipomyelomeningocele, Fat-Dural lipomas, Filar lipomas.

- **Spinal Location**

Lumbosacral, Lumbar, Dorsal, Cervical.

- **Vertebral Anomalies**

Spina bifida, Butterfly vertebra, Hemi vertebra, Block vertebra, Others.

- **Spinal Curvature anomalies**

Scoliosis, Kyphosis, Lordosis

- **Septum in Diastematomyelia**

Bony, Fibrous

Statistical Analysis

Collected data was entered in Microsoft Excel 2016, for further statistical analysis, categorical data was expressed in frequency and proportion. Descriptive statistics was used to expressed data. Statistical analysis was done with the help of statistical Software SPSS version 25.

Observation and Results

Table 1 : Demographic Distribution among study population

Parameter	Frequency	Percentage
Age		
1 - 5 Years	16	32
6- 10 Year	20	40
11 -15 Year	11	22
15 -20 Year	3	6
> 20 Year	0	0
Gender		
Male	21	42
Female	29	58

Table 2 : Distribution of Open and Occult Spinal Dysraphism

Type	Male	Female	Total
Open Spinal Dysraphism			
Myelomeningocele	13(34.21%)	25(65.78%)	38(100%)
Myelocele	0(0%)	2(4%)	2(100%)
Meningocele	1(100%)	0(0%)	1(100%)

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Occult Spinal Dysraphism			
Spinal lipomas	4(80%)	1(20%)	5(100%)
Diastematomyelia	3(100%)	0(0%)	3(100%)
Dorsal dermal sinus	0(0%)	1(100%)	1(100%)
Tight filum terminale	0(0%)	1(100%)	1(100%)
Anterior sacral meningocele	0(0%)	0(0%)	0(0%)
Sacral agenesis	0(0%)	0(0%)	0(0%)

Table 3 : Distribution of Spinal Lipomas of Occult Spinal Dysraphism

Parameter	Frequency	Percentage
Spinal Lipomas		
Lipomyelocele	0	0%
Lipomyelomeningocele	3	6%
Dural lipomas	1	2%
Filar lipomas	1	2%

Table 4 : Distribution of Diastematomyelia and site of involvement

Parameter	Open SD	Occult SD	Total
Diastematomyelia			
Fibrous Septum	3	2	5
Boney Septum	3	1	4
Site of Involvement			
Cervical	0	0	0
Dorsal	1	1	1
Dorsolumbar	2	1	3
Lumbar	3	1	4
Lumbosacral	1	0	1

Table 5 : Distribution of Tethering of cord, Hydroxylian and Hydrocephalus

Parameter	Open SD	Occult SD	Total
Tethering of Cord			
Tethering	3	4	7
No Tethering	37	6	43
Hydroxylian			
Present	11	4	15

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Absent	29	6	35
Hydrocephalus			
Present	18	4	22
Absent	22	6	28

Table 6 : Distribution of Vertebral anomalies and Spinal Dysraphism in spine

Parameter	Open SD	Occult SD	Total
Vertebral Anomalies			
Hemivertebra	15	4	19
Butterfly vertebra	16	4	20
Block vertebra	7	1	8
Spina bifida	40	9	49
Others	1	0	1
Spinal Dysraphism in Spine			
Cervical	3	1	4
Dorsal	9	1	10
Lumbar	12	3	15
Lumbosacral	16	5	21

Table 7 : Distribution of Spinal Curvature among study population

Parameter		Open SD	Occult SD	Total
Spinal Curvature				
Scoliosis	Cervical	1	1	2
	Dorsal	4	4	8
	Lumber	4	3	7
Kyphosis	Dorsal	3	4	7
	Lumber	1	2	3
Lordosis	Lumber	3	2	5
Total		16	16	32

Table 8 : Distribution of Spinal Curvature among study population

	Parameters	Evaluation
1	Open SD	
	Myelomeningocele	Good
	Myelocele	Good
	Meningocele	Good
2	Occult SD	

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	Spinal lipomas	Good
	Diastematomyelia	Good
	Dorsal dermal sinus	Good
	Tight filum terminate	Poor
	Anterior sacral meningocele	Good
	Sacral agenesis	Good
3	Vertebral Anomalies	Excellent
4	Spinal Dysraphism in Spine	Good
5	Spinal Curvature	Good
6	Tethering	Poor
7	Hydromylia	Good
8	Hydrocephalus	Good
9	Chiari Association	Good

Discussion

When using CT to evaluate spinal dysraphism, a contrast agent may be injected into the patient's bloodstream to enhance the visibility of certain structures. CT can help identify spinal cord malformation, such as tethered spinal cord syndrome or lipomyelomeningocele, which are associated with spinal dysraphism

A study published in the journal of Neurosurgery: Paediatrics in 2018 looked at the clinical and radiological characteristics of 60 patients with lipomyelomeningocele, a type of spinal dysraphism. The study found that early surgical intervention resulted in better outcomes and reduced the risk of complication. Another retrospective study published in the journal of pediatric orthopaedics in 2020 examined the incidence and risk factors for scoliosis in patients with myelomeningocele, a type of spinal dysraphism. The study found that the prevalence of scoliosis was high in these patients and identified certain risk factors, such as ambulatory status, that increased the likelihood of developing scoliosis

In our study all cases of open Spinal dysraphism occurred in the first two years of life with no cases beyond that age group. Occult Spinal dysraphism patients presented at later age group in the first, second and third decade with most of the cases occurring in the first decade. (Mean age of presentation is 7.38 yrs). In open spinal dysraphism there were 13(34.21%) males and 28(65.79%) thus showing female predominance (M:F 1:2.15), while in occult spinal dysraphism 7(70%) were male and 3(30%) were females, showed male dominance in the ratio of 2.5:1 these results were comparable with the studies conducted by Steinbok P et al[1] and Tripathi et al [2]

In our study we have observed total 41(82%) were of open spinal dysraphism and 10 patients were with occult spinal dysraphism. Study conduced by Kumar R Singh et al[3] showed an incidence of 76.77% and 23.33% of open and occult spinal dysraphism. In the open SD the 38(92.68%) cases of Myelomeningocele were most common lesion followed by Myelocele and meningocele. Study conducted b Kumar R et al showed 72%, 2% and 1% for above lesion respectively. The lesions were distributed in the Cervical, Dorsal, Lumbar and Lumbosacral regions, the Lumbosacral region was the most common site accounting for 40% followed by lumbar and dorsal which was comparable with study conducted by Singh .N. et al study which showed 38% for the Lumbosacral region. Most common lesion in occult SD was spinal lipomas among 4 patient out of 10 and among it Lipomyelomeningocele accounting

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for 75% of spinal lipomas followed by Lipomyelocele, study by Naidich TP et [4] comparable to our study. Study done by Kumar R Singh et al study showed 4.5% for dorsal dermal sinus. Another study by Fitz CR et al and Love JG [5, 6] showed that Tight filum terminate syndrome was an uncommon lesion among occult SD, which also proved in our study found in only one patient.

Tethering occurred in 3 cases of open spinal dysraphism and 4 cases of occult SD. Study conducted by Ragavan et al [7] supported to our results. In open SD 2 cases were of spinal lipomas and one of Diastermatomyelia. Among vertebral anomalies 49 cases occurred of spinabifida which was most common vertebral anomaly followed by butterfly vertebra and hemivertebra supported by Tripathi P et al[2]

In our study most common spinal curvature anomaly was scoliosis followed by Kyphosis and Lordosis. In open SD scoliosis dorsal and lumber observed most common and in Occult SD dorsal was observed most common followed by lumber. In Kyphosis and Lordosis in both open and occult dorsal spine and Lumber spine were observed more common which was supported study conducted by Barson AJ etal [8] which also showed a predominance of scoliosis

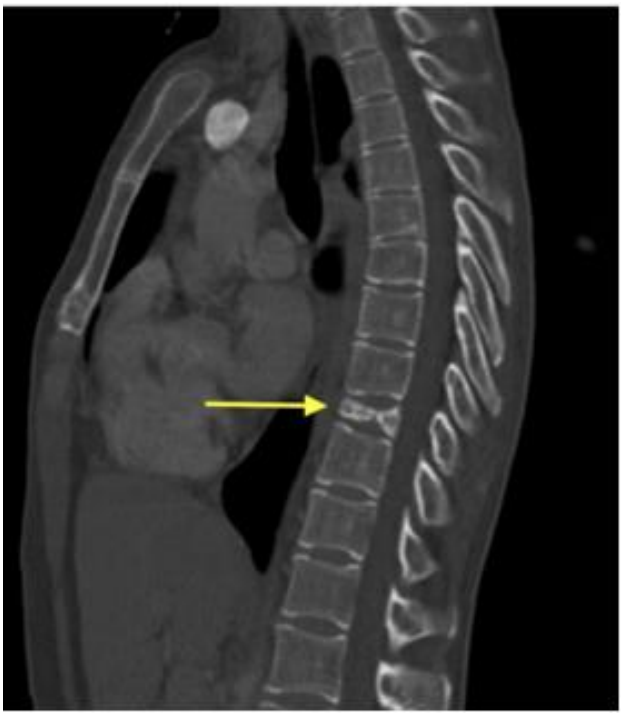

Figure 1 : CT spine was performed on a 15 year girl who was in a road traffic accident. shows that this appearance is due an unusual ‘butterfly’ shape to the vertebral body caused by congenital incomplete fusion of the two halves of the vertebra.

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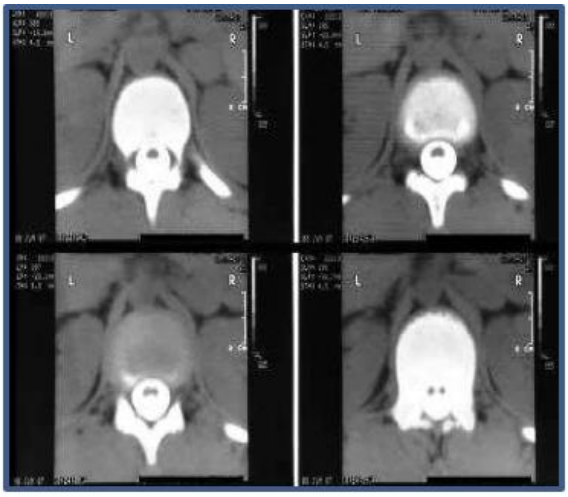

Figure 2: Axial CT Scans through the upper lumbar spine show a split cord

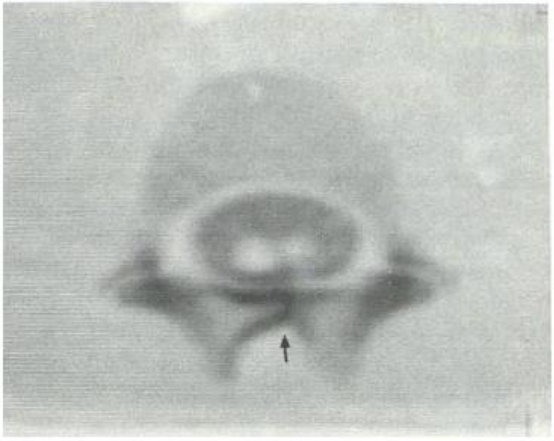

Figure 3: 5-year-old girl with small right leg and absent right ankle jerk. Fair myelographic demonstration of split cord . Spina' bifida occulta at L3. Patient had surgery for un tethering of low fixed cord.

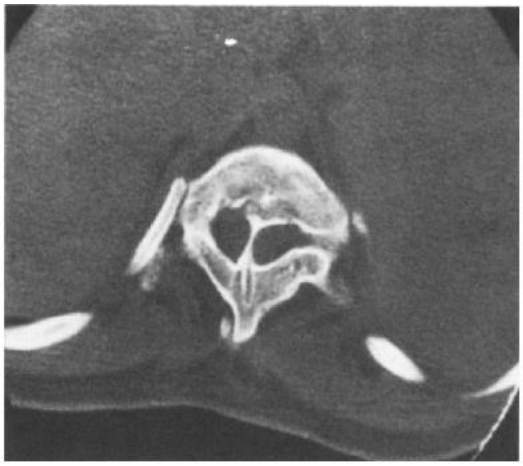

Figure 4 : Diastematomyelia with bone spur. Noncontrast CT discloses the typical bony changes of this form of iastematomyelia: a sagittally short, broad vertebral body; short, thick laminae; a stubby spinous process; a sagittally oriented bone spur which extends between the vertebral body and the lamina to form two nearly symmetrical hemicanals; and scoliosis which rotates the vertebral body and the spur away from the midsagittal plane.

Conclusion :

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From overall observation and discussion with other studies in our study we can conclude that, CT can be a useful tool in the evaluation of spinal dysraphism, particularly for the assessment of bony structure, also it showed that multiplanar reformatted CT is an excellent imaging modality for characterization of vertebral segmentation defects, spinal curvature anomalies associated with SD. However, the decision to use CT should be individualized based on the specific clinical situation and should be made in consultation considering potential benefits and risk of the procedure.

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Conflict of Interest : None

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