ORIGINAL ARTICLE

Lumbosacral dysraphism as cause of neurogenic bladder: Magnetic Resonance Imaging based study from SIUT Pakistan

Saima Sadiq,[1] Syed Muhammmad Faiq,[2] Muhammad Khalid Idrees[3]

Abstract

Objective: To find the frequency and types of spinal dysraphism in patients presenting with neurogenic bladder dysfunction.

Methods: The cross-sectional study was conducted at the Sindh Institute of Urology and Transplantation, Karachi, from February to September 2011, and comprised patients of either gender 5-15 years of age with neurogenic bladder suspected to be due to lumbosacral dysraphism. They all had magnetic resonance imaging of lumbosacral spine. All images were reviewed by an experienced radiologist and patients were diagnosed as having spinal dysraphism and were categorised according to the radiological features. Data was analysed using SPSS 10.

Results: Of the 175 patients in the study, 96(55%) were males and 79(45%) were females with an overall mean age of 7.3±2.15 years (range: 5-15 years). Spinal bony defects were found in 110(62.8%) patients, and of these, 96(87%) had spinal dysraphism. Myelomeningocele, meningocele and sacral agenesis was found in 58(60.4%) of the 96 patient with spinal dysraphism.

Conclusion: Spinal dysraphism is the most common cause of neurogenic bladder in children up to 15 years of age and myelomeningocele, meningocele and sacral agenesis comprised more than 60% of such cases.

Keywords: Spinal, dysraphism, bifida, bladder, dysfunction. (JPMA 65: 501; 2015)

Introduction

Any lesion between central nervous system (CNS) and urinary bladder can produce neurogenic voiding dysfunction[1] and children with neurogenic bladder dysfunction may be unable to retain urine normally, to evacuate normally or both.[2]

Neurospinaldysraphism (spina bifida/lumbosacral spinal dysraphism) is the most common cause of neurogenic bladder among children.[3] Spinal dysraphism/spina bifida is uncommon in the United States and the prevalence of 2.4/10000 among children between 0-19 years of age was recorded in Atlanta.[4] Spina bifida is relatively common in Iran with incidence of 11.3/10000 births.[5] In Pakistan the exact incidence of spina bifida is not known, but a study from Rahim Yar Khan found that the incidence of open neural tube defect was 7-8/1000 live births and among them spina bifida accounted for 28.85%.[6] A study from Karachi showed that neural tube defect was the commonest congenital anomaly and spina bifida accounted for 19.5% of all the congenital anomalies.[7] A study based on magnetic resonance imaging (MRI) from Peshawar[8] reported that out of the 60 patients who underwent multiplanar MRI lumbosacral spine examination, 17(28.3%) had spinal dysraphism, with 15 patients having spina bifida, 11 had tethered cord, 10 had a myelomeningocoele, 7 had a diastematomyelia, 6 had associated spinal lipomas, 3 had a dermal sinus tract, 2 had myelocoeles and 1 had an associated dermoid cyst. Patients with neurogenic bladder and other underlying structural anomalies are more susceptible to urinary tract infection (UTI).[9] Neurogenic bladder caused by spina bifida is an important cause of renal failure in children in developing countries and early intervention can prevent this disastrous complication.[10]

Plain radiograph of the lumbosacral spine may reveal failure of fusion of the posterior arch, hemivertebrae, sacral agenesis, spur of diastematomyelia, and signs indicating the presence of spina bifida. However, in paediatric patients, the radiological diagnosis (X-ray) is impaired by incomplete ossification and myelodysplasia/spinal dysraphism might be present with no evidence of bone alterations.[11] Spinal dysraphism can be diagnosed by neonatal spinal ultrasound, but MRI is more specific, non-invasive and confirmatory diagnostic modality.[12]

The current study was planned to find the frequency and types of spinal dysraphism among patients presenting with neurogenic bladder dysfunction at our institution. The study will likely provide the magnitude of spinal dysraphism, so that data could be utilised for planning purposes.

[1,2]Department of Radiology, [3]Department of Nephrology, Sindh Institute of Urology and Transplantation, Karachi, Pakistan.

Correspondence: Saima Sadiq. Email: drsaimakhalid6@gmail.com

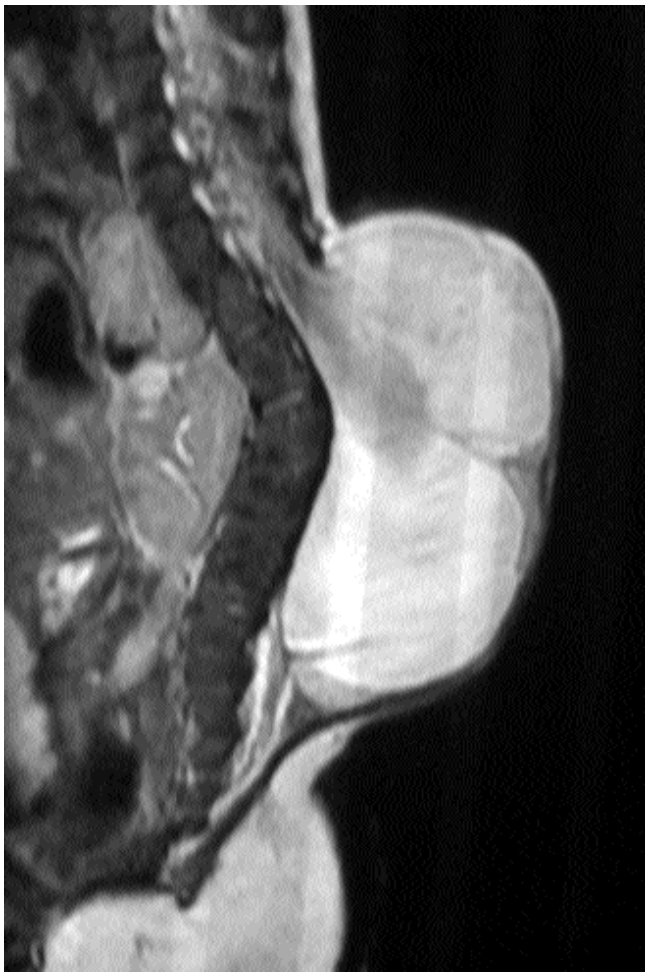
Patients and Methods

The cross-sectional study was conducted at the Sindh Institute of Urology and Transplantation (SIUT), Karachi, from February to September, 2011, and comprised patients of both genders 5 to 15 years of age with symptoms of neurogenic bladder and diagnosed on urodynamic studies as spastic or flaccid neurogenic bladder. Patients having neurogenic bladder secondary to trauma, cerebral palsy (CP) or infections were excluded as were those in whom MRI was contraindicated. Informed consent was obtained after the whole procedure had been explained to the patients and their parents/guardians. MRI of lumbosacral spine, axial T1 (TE,42,68,85 and 102msec; TR, 675msec) and T2 (TE, 42-106msec; TR, 700-4000msec) weighted images, sagittal fast spin echoT1 (TE,42-102msec; TR, 400-675msec) and T2 fast recovery fast spin echo (TE,110; TR,700-4000msec) weighted images were performed with a 1.5 Tesla Signa Excite II. MR myelography was also performed by a senior technologist. Images were taken from 12th thoracic to 5th sacral vertebrae and 5mm slice thickness was taken. Children, if needed, were sedated under full anaesthesia cover. All images were reviewed by an experienced radiologist having experience of over 5 years. Patients were diagnosed as having spinal dysraphism and were categorised according to radiological features on MRI. All information obtained was recorded on a pre-designed proforma. Using SPSS 10, data was analysed for variables, including age, gender, clinical features and MRI features of spinal dysraphism. Mean ± Standard deviation (SD) values were measured for quantitative variables (age, duration of complaint) and proportions for qualitative variables (gender, clinical features, MRI features of spinal dysraphism). Frequency tables for these variables were drawn on Microsoft Excel. As this was a cross-sectional study, test of significance was not needed and only the frequency and presence of spinal dysraphism on MRI lumbosacral spine was determined.

Results

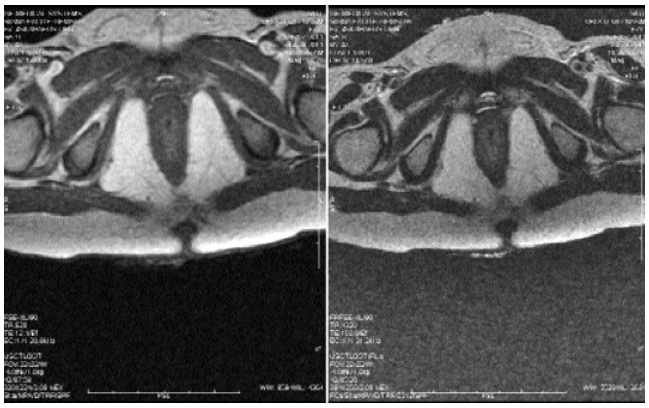
Of the 175 patients in the study, 96(55%) were male and 79(45%) were females, with an overall mean age of 7.3±2.15 years (range; 5-15 years). Most of the patients 168(96%) were Pakistani nationals, while 7(4%) were Afghan refugees living in Pakistan. Overall, 135(77%) patients were less than 12 years of age and 40(27%) were more than 12. MRI lumbosacral spine and MR myelography was done according to the prescribed protocol.

Dribbling of urine was the most common presenting complaint 42 (24%) followed by urgency 37 (21%), nocturia 28 (16%) and incomplete bladder emptying in



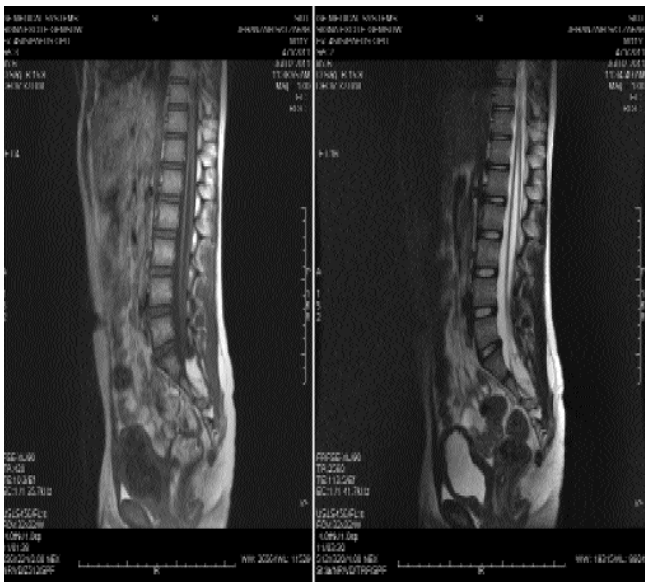
Sagittal section of lumbosacral spine in T2-weighted image showing kyphotic deformity of spine with meningomyelocele

Figure-1: Meningomyelocele.



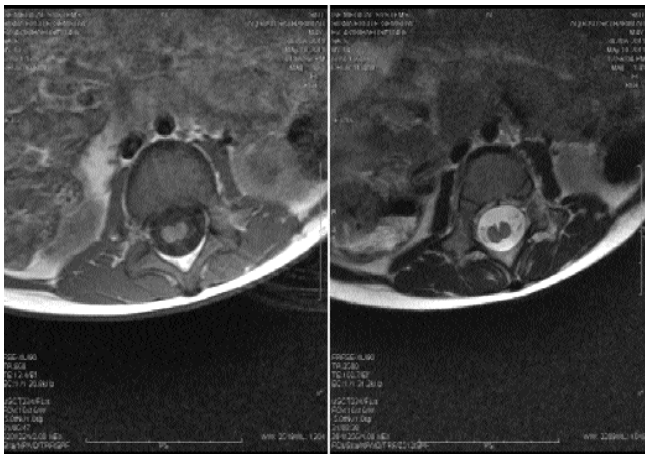
Axial sections of T1 and T2-weighted images showing dermal sinus in coccygeal region.

Figure-2: Dermal sinus.



Sagittal section of lumbosacral spine in T1-weighted and T2-weighted images showing low-lyingspinal cord, large syrinx and lipomatous mass in sacral spinal canal.

Figure-3: Low-lying spinal cord.

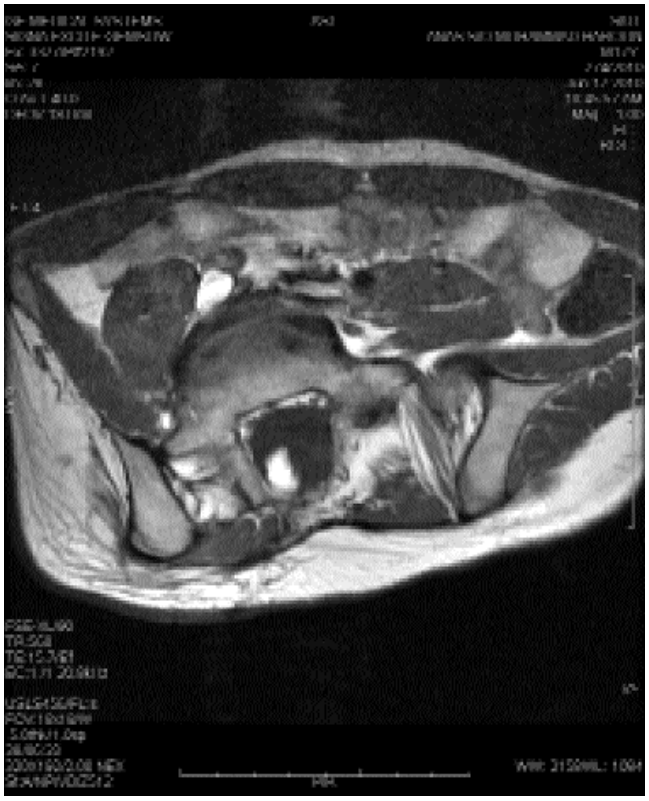


Axial section of lumer spine in T1-weighted and T2-weighted images showing two hemicords representing diastometomyelia.

Figure-4: Diastometomyelia.

21 (12%). Overall, 23(13%) patients had history of recurrent UTIs and had received frequent courses of antibiotics. Besides, 120(68%) patients had complaints for more than a year. Urgency, nocturia and recurrent UTI were the most common complaint that had duration of more than one year at the time of presentation. Urinary retention got the earliest attention by the parents.

Spinal bony defects were found in 110(62.8%) patients.



Axial section of lumbar spine in T1-weighted image showingspina bifida at L5 level and intraspinal lipoma.

Figure-5: Intraspinal lipoma.

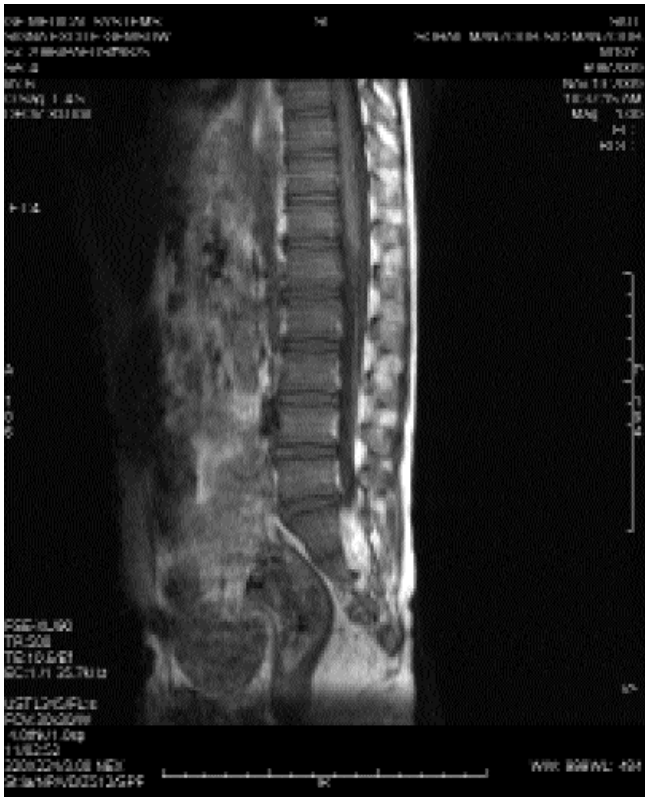
Table-1: Types of spinal dysraphism: MRI findings.

MRI findings	Males	Females	Total
Myelomeningocele	14	11	25
Meningocele	11	9	20
Sacral agenesis	7	6	13
Low lying spinal cord	6	5	11
Dermoid	3	3	6
Lipoma	4	2	6
Tethered cord	2	2	4
Diastometomyelia	1	3	4
Dermal sinus	2	2	4
Tight filum terminale	2	1	3
Total	52	44	96

Out of them, 96(87%) had spinal dysraphism (Table-1). The remaining 14(13%) of the 110 patients had spinal bony defects without spinal dysraphism; spina bifida occulta. In the rest of the 65(37%) patients, either the MRI study was normal or unrelated defects were found. Myelomeningocele, meningocele and sacral agenesis was

Table-2: Age and diagnosis.

MRI findings	Males		Females		Total
	<12 years	>12 years	<12 years	>12 years	
Myelomeningocele	11	3	7	4	25
Meningocele	7	4	7	2	20
Sacral agenesis	5	2	5	1	13
Low lying spinal cord	4	2	3	2	11
Dermoid	2	1	3	0	6
Lipoma	3	1	1	1	6
Tethered cord	1	1	1	1	4
Diastometomyelia	1	0	2	1	4
Dermal sinus	2	0	1	1	4
Tight filum terminale	1	1	1	0	3
Total	37	15	31	13	25



Sagittal section of lumbosacral spine in T1-weighted image showing caudal regression syndrome type 1, spina bifida at L4 and L5, low-lying and tethered cord with intraspinal lipoma.

Figure-6: Caudal regression.

found in 58(60.4%) of the 96 patient with spinal dysraphism. Rest of the patients with spinal dysraphism had dermoid at conusmedullaris/intraspinaldermoid, low-lying spinal cord, diastometomyelia, tethered spinal cord, lipoma, dermal sinus and tight filumterminale as the cause of neurogenic bladder (Figures-1-6). Age below and over 12 years was also noted for each diagnosis (Table-2).

Discussion

Out of 175 patients included in this study, 96 (54.8%) had spinal dysraphism. The exact incidence of spinal dysraphism in Pakistan is not known, but a study from Peshawar[13] showed that out of 3310 deliveries, spinal dysraphism (spina bifida with meningocele) was found in 8(2.4/1000) and another study from Rahim Yar Khan showed that spinal dysraphism accounted for about one-third all neural tube defects which had incidence of 7-8/1000 live births. This is much higher than the incidence reported from US, and less than Iran and Saudi Arabia.[14] The study was aimed at finding the frequency and types of spinal dysraphism among patients who had neurogenic bladder and underwent MRI lumbosacral spine at our institution. At birth, spinal dysraphism tends to be more common in girls than in boys.[15] The higher frequency of males in this study may be because males are given preference over females in our male-dominated society.[16] The male predominance among patients with spinal dysraphism has also been reported from India[17] and Iran.[18] Dribbling of urine, urgency and nocturia were the most frequent symptoms of the patients with neurogenic bladder included in this study. Urinary incontinence was found among 42 (44%) patients compared to 77% reported from Iran.[19]

Meningomyelocele and meningocele were the most common diseases causing neurogenic bladder. An MRI-based study from Peshawar[8] found that out of the 60 patients who underwent multiplanar MRI lumbosacral spine examination, 17 (28.3%) had spinal dysraphism, with 15 having spina bifida, 11 tethered cord, 10 myelomeningocele, 7 diastematomyelia, 6 associated spinal lipomas, 3 had a dermal sinus tract, 2 myeloceles and 1 had an associated dermoid cyst. A study from Iran which included 94 patients with spinal dysraphism reported 70 (74.5%) patients had myelomeningocele, 2(2.1%) lipomeningocele, 1(1.1%) meningocele, 1(1.1%) sacral agenesis and 20(21.3%) had other types of occult spinal dysraphism.[19] The difference in frequency of various types of spinal dysraphism may reflect differences in local demographics of disease and study population.

While 96 patients had spinal dysraphism in our study, 14 had spina bifida occulta (bony defect only, no neuronal tissue involved) and 65 patients had either normal spine or un-related disorder. Spina bifida is found up to 17% of examined spine[20] and its association with spinal cord dysfunction is yet not clear.[21] A study in India found no difference in the outcome of enuresis patients with spina

bifida occulta and those not having this anatomical abnormality.[22] A number of studies found that upto 10% patients with congenital neurogenic bladder had no other aetiology identified except spina bifida occulta.[23] In occult spinal dysraphism (spina bifida occulta), tethering interferes with the normal postnatal ascent of the conusmedullaris (most significantly in the first few months of life) and results in ischaemic damage to the spinal cord with subsequent neurological dysfunction and bladder involvement.[24] This may explain the finding of neurogenic bladder in patients with spina bifida alone.

MRI is a safe and radiation-free investigation and it is the investigation of choice for spinal cord disorders. Early detection of spinal dysraphism and its timely management can prevent neurogenic bladder and its consequences, including, but not limited, to UTI and renal failure.

Conclusion

Spinal dysraphism is the most common cause of neurogenic bladder in children up to 15 years of age and myelomeningocele, meningocele and sacral agenesis comprise more than 60% such cases. MRI lumbosacral spine is helpful in finding the aetiology of neurogenic bladder in this population.

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