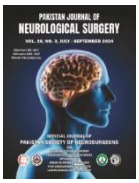

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Original Research

Outcome of Spinal Dysraphism Surgery without Electrophysiological Monitoring in a Resource-Constrained Country; 5-Year Experience: A Way Forward for Pediatric Neurosurgery

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ABSTRACT

Objective: This study aimed to see the outcome of spinal dysraphism surgery without electrophysiological monitoring.

Materials & Methods: A prospective study was conducted in the department of neurosurgery, Jinnah Hospital Lahore. A total of 125 patients were included in the study. Data was collected on a proforma regarding symptoms, location, variety, surgical technique, and rehabilitation, and analyzed for the outcome.

Results: Out of 125 patients, 30 patients presented with swelling, 65 with cutaneous stigmata and 30 had neurological deficits. The spinal dysraphism was located in the lumbosacral region in the majority (63%) of cases and no patient was found to have it in the cervical region. 76% of patients had static outcomes despite a lack of electrophysiological monitoring, 17% of patients showed improvement in neurological deficits and 7% deteriorated.

Conclusion: The outcome of surgery for spinal dysraphism even without intraoperative electrophysiological monitoring can be satisfactory if done carefully by an expert team.

Keywords: Spina bifida, motor evoked potentials (MEP), tethered cord syndrome (TCS), somatosensory-evoked potentials (SSEPs), IONM (intraoperative neurophysiological monitoring).

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INTRODUCTION

Spinal dysraphism is the failure of the fusion of midline structures of the spine. It is divided into two groups; spina bifida aperta and spina bifida occulta. Electrophysiological studies are highly valuable for evaluating pre and postoperative patients and more importantly, for monitoring during surgery. Motor-evoked potentials (MEPs) and somatosensory-evoked potentials (SSEPs) are commonly practiced tools. This monitoring can reduce complications and lead to a better outcome. In the pre-antibiotic era, patients with spina bifida were not expected to survive especially in exposed dysraphism, because the spinal cord and, thus, the central nervous system are exposed to the environment. Most of the survivors are handicapped. The debate over whether surgical treatment should be offered or whether the disease should be allowed to take its natural course has been resolved in favor of treatment after the advancement in neurosurgical operative techniques.[1]

Spinal dysraphism is the result of failure of fusion of midline structures of the spine and is divided into two broad categories; Spina bifida aperta and spina bifida occulta. In the first category, the underlying neural canal structures are not covered by normal skin. Myelomeningocele and myeloschiasis are examples. In spina bifida occulta, the underlying structures are covered by normal skin. Lipomyelomeningocele, meningocele, and congenital dermal sinus are examples of this category[1]. During the 4th week of gestation, incomplete closure of the neural tube leads to this defect and the patient can suffer from lifelong paralysis and incontinence that has emotional and socioeconomic implications[2]. Consumption of 400 micrograms of folic acid daily before conception and during the first trimester prevents 50-70% of these defects.[3,4,5]

Neurophysiological monitoring provides reliable and sensitive methods for assessing both ascending and descending functions of the spinal cord in the diagnostic laboratory and the operating room. Electrophysiological studies are highly valuable for evaluating patients pre and postoperatively, and more importantly for intraoperative monitoring. Motor-evoked potentials (MEPs) and somatosensory-evoked potentials (SSEPs) are commonly practiced tools.[6,7]

In developing countries, the lesser availability of monitoring is a major hindrance to prognosis. The management of meningomyelocele study (MOMS) trial (2011) concluded that if surgery is done before 26 weeks of gestation, the outcome is much better and the incidence of complications is reduced.[8,9]

Due to the non-availability of electrophysiological monitoring in our department, the surgery for spinal dysraphism was done without it and the aim was to assess the outcome of this surgery without electrophysiological monitoring and to improve pediatric neurosurgery skills.

MATERIALS & METHODS

Study Type & Settings

A prospective study was conducted for six years from January 2017 to December 2022 at the Department of Neurosurgery, Jinnah Hospital, Lahore with ethical approval from the institution (Ref# ERB162/9/04-04-2024/SI ERB). Informed consents were taken from the patients.

Inclusion Criteria

Children of both genders, aged more than 2 months, and having spinal dysraphism were included in the study.

Exclusion Criteria

Children admitted for revision surgery, having CSF leak from dysraphism area, documented preoperative meningitis, and having paraplegia were excluded.

Data Collection

A total of 125 patients were enrolled and the data was collected on a designed proforma and data regarding symptoms, location, type, surgical technique, and neurorehabilitation was collected. All patients presenting with spinal dysraphism who met inclusion criteria, and were fit for surgery were included in the study. All patients included in the study were operated by a faculty member (at least an assistant professor), a qualified neurosurgeon. Data were analyzed for the outcome based on operational definition.

RESULTS

Age Distribution

The majority of patients (48%) were between 3-4 months followed by 4-5 months (32%) (Table 1).

Table 1: Age distribution.

Age	Frequency (%)
2-3 months	25(20%)
3-4 months	60(48%)
4-5 months	40(32%)

Gender Distribution

Spinal dysraphism was found to be more common in female children (60%) compared to males (40%) with female: male ratio of 3:2 (Table 2).

Table 2: Gender distribution.

Gender	Frequency (%)
Male	50(40%)
Female	75(60%)

Symptoms and Signs of Spinal Dysraphism

A total of 125 patients were included. Out of these, 30 patients presented with swelling, 65 with cutaneous stigmata, and 30 with neurological deficits (Table 3).

Table 3: Symptoms and signs of spinal dysraphism.

Sign and Symptoms	Frequency (%)
Cutaneous stigma	65 (52%)
Swelling	30 (24%)
Neurological deficit	30 (24%)

Location of Spinal Dysraphism

In our study, the spinal dysraphism was mostly located in the lumbosacral region (63%), and there was no case documented in the cervical region (Table 4).

Table 4: Location of spinal dysraphism.

Location	Frequency (%)
Lumbosacral	63(52.9%)
Lumbar	39(31.2%)
Dorsal	23(19.3%)
Cervical	0 (0%)

Variety of spinal Dysraphism

Spina bifida cystica i.e. meningocele without hydrocephalus has more prevalence (29.6%), mostly occurring without hydrocephalus. Among spina bifida occulta, lipomyelomeningocele is the most common occurrence (21.6%) followed by thickened filum terminale (8%) (table 5) (Figure 1).

Table 5: Variety of spinal dysraphism.

Variety	Frequency (%)
Spina bifida aperta	**79 (63.2%)**
Meningocele with hydrocephalus	13 (16.4%)
Myelomeningocele with hydrocephalus	10 (12.6%)
Meningocele without hydrocephalus	41 (51.8%)
Myelomeningocele without hydrocephalus	15 (18.9%)
Spina bifida occulta	**46 (36.8%)**
Lipomyelomeningocele	27 (21.6%)
Thickened filum terminale	10 (8%)
Split cord malformation	6 (4.8%)
Dermal sinus	3 (2.4%)

Surgical Technique Used to Repair the Defect

Excision and repair of spinal dysraphism was

performed in 80 patients, untethering of the cord in 6 patients (Figure 2) while 29 patients required reconstructive surgery with the help of the Department of Plastic and Reconstructive Surgery (table 6).

Figure 1: Tethered cord syndrome; low-lying conus medullaris with thickened filum terminale. (Image included with permission).

Table 6: Surgical technique used to repair the dysraphism.

Technique	Frequency (%)
Excision and repair only	80 (68.9%)
Release of thickened filum terminale	10 (8.6%)
Detethering of cord	6 (5.1%)
Reconstructive surgery	29 (23.2%)

The outcome of the Patients After Surgery

In our study, 96 (76%) patients had static outcomes despite of lack of electrophysiological monitoring, 21 (17%) showed improvement in neurological deficits while the neurology of 8 (7%) patients deteriorated (table 7).

Figure 2: Preoperative finding of thick filum terminale, ready to be sectioned. (Image included with permission).

Table 7: Outcome of the patients after surgery.

Outcome	Frequency(%)
Improved	21(17%)
Static	96(76%)
Deteriorated	8(7%)

DISCUSSION

Spinal dysraphism is the result of failure of fusion of midline structures of the spine and is divided into two broad categories; Spina bifida aperta and spina bifida occulta.[1]

In our study, surgery for spinal dysraphism was performed on 80 patients, 6 patients had detethering of the cord and 29 patients had reconstructive surgery. 76% of patients had static outcomes despite a lack of electrophysiological monitoring, 17% of patients showed improvement in neurological deficits and 7% deteriorated. The results of our study are similar to the study by Sajid Hussain, 75% of their patients were of spina bifida aperta while in our study, it was 63.2%.[10] According to our study, 17% of patients showed improvement while 76% remained in their previous condition. Raj Kumar et al concluded that 45% of patients improved while 43% remained static.[11,12] As our institution has a reconstructive surgery specialty available, our 29 patients underwent reconstructive surgery in the same sitting after a multidisciplinary team discussion preoperatively.

Spinal dysraphism involves the lumbosacral region (74.8%) most frequently, as published by Ahmed et al. There was no patient with a lesion in the cervical region.[13,14] Type of spina bifida in our study was comparable to Sajid Hussain's study, 75% of their patients presented with spina bifida aperta while it was 63.2% in our study.[15] According to our study, 17% of patients improved while 76% remained in their previous condition. Raj Kumar et al reported that 45% of patients improved and 43% remained static.[16] Analyzing the outcomes of 326 pediatric cases, Shang et al, found postoperative urinary retention in six cases (1.8%), lower extremity numbness in nine cases (2.8%), and lower extremity weakness in 3 cases (1%).[16,17]

In a study conducted at the University of California, no patient developed new neurologic symptoms or signs postoperatively. Bowel and bladder function improved in 46% of patients, back pain in 39%, and motor function in 31%. Eight percent of patients reported a decline in bladder control and worsening of back pain postoperatively[13] while in our study, 76% of patients had static outcomes and 7% deteriorated.

Our institution has an established department of plastic and reconstructive surgery and 29 patients in our study underwent reconstructive surgery as a joint undertaking after multidisciplinary team discussion preoperatively to avoid complications.[18,19]

The outcome of surgery remained static in 76% of our patients despite the lack of electrophysiological monitoring which is motivating and fascinating for young neurosurgeons to provide care to these patients even in general neurosurgical wards and it is the responsibility of trained supervisors to pass on the skills of pediatric neurosurgery to young consultants in resource-constrained departments of the country.

RECOMMENDATIONS

The presence of a substantial sample size along with the availability of neuromonitoring services and the establishment of dedicated pediatric neurosurgery units within all neurosurgery departments are future recommendations.

CONCLUSION

The outcome of surgery for spinal dysraphism even without intraoperative electrophysiological monitoring can be satisfactory if done carefully by an expert team.

Conflict of Interest

No conflict of interest of any participant was involved in this study.

Data Availability Statement

All the data is available on request. Interested researchers can contact manzoor63@gmail.com

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Additional Information

Disclosures: Authors report no conflict of interest.

Ethical Review Board Approval: The study conformed to the ethical review board requirements.

Human Subjects: Consent was obtained by all patients/participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR'S CONTRIBUTION

S. No.	Name of Author	Contribution
1.	Adeel Rauf	Data collection.
2.	Usman Ahmad Kamboh	Literature review.
3.	Aiqa Gulshan	Data collection.
4.	Zaid Sami Ullah	Methodology.
5.	Sana Jamal	Data analysis.
6.	Manzoor Ahmad	Discussion & overview.
7.	Naveed Ashraf	Editing & overview.