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Evaluating causes and treatment outcomes in pediatric neurological disorders: A retrospective study

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Abstract

Background: Pediatric neurological disorders pose significant healthcare challenges, especially in resource-limited regions. This study examines the demographic characteristics, common diagnoses, and treatment outcomes of pediatric patients with neurological disorders at Elshamal Specialized Hospital in Northern Sudan.

Objectives: The primary aims of this study are to:

Assess the demographic characteristics (sex, age, and residence) of pediatric patients with neurological disorders.

Evaluate the treatment outcomes for these patients at Elshamal Specialized Hospital.

Methods: A descriptive, retrospective, cross-sectional study was conducted from December 1, 2023, to October 1, 2024. Data were collected from 200 pediatric patients (ages 0-18 years) referred to the neurology clinic. Information regarding demographics, diagnoses, treatment received, and outcomes was extracted from patient files and hospital records.

Results: The study included 200 patients, with 127 males (63.5%) and 73 females (36.5%). The majority were aged 0-10 years, with 80 patients (40%) in the 0-5 years category and 81 (40.5%) in the 5-10 years category. A significant portion (78%) resided in the North State. The most common diagnoses were Cerebral Palsy (32%), Epilepsy (29.5%), and Encephalitis (6%). Notably, 105 patients (52.5%) fully improved, 55 patients (27.5%) are currently improving, and 39 patients (19.5%) have shown no improvement (static), indicating a need for further evaluation. There was 1 death (0.5%), representing a low mortality rate.

Conclusion: This study highlights the prevalence of neurological disorders among children in the studied population and underscores the effectiveness of current management strategies. The findings indicate a critical need for improved pediatric neurological services, particularly in conflict-affected regions. Further research is necessary to explore factors influencing treatment outcomes and the ongoing effects of healthcare professional migration due to regional instability.

Keywords: Causes; Outcome; Pediatric Neurological Disorders

1. Introduction

Elshamal Specialized Hospital is a healthcare facility in Northern Sudan that functions as a referral center for pediatric neurology. With an estimated population of one million, predominantly children, understanding the prevalence and

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outcomes of neurological disorders within this demographic is vital for improving health services. The hospital has experienced an influx of patients, largely due to the ongoing conflict in Sudan, necessitating a comprehensive evaluation of the types of neurological disorders encountered and their treatment outcomes.

There is a widespread misconception that neurological disorders are primarily a concern in high-resource settings. However, epidemiological data from the Global Burden of Disease study reveal that neurological conditions significantly contribute to morbidity and mortality in resource-limited settings. In 2015, neurological disorders were the leading cause of disability-adjusted life years (DALYs) lost, accounting for 10.2% of global DALYs. They were also the second-leading cause of death globally, responsible for 16.8% of deaths, with a disproportionate burden of DALYs lost and mortality observed in low- and middle-income countries (LMICs) [1].

Critically ill children face the risk of both primary and secondary neurological injuries, which significantly influence their neurodevelopmental outcomes. Predicting these outcomes is particularly challenging due to the numerous factors that affect each child's neurodevelopment. These factors include, but are not limited to, age, socioeconomic status, pre-existing neurodevelopmental disabilities, genetic predispositions, type of injury, length of PICU stay, and medications administered [2].

Epilepsy is the most frequently observed neurological disorder, followed by behavioral disorders and cerebral palsy. A notable difference was found between children under 5 years and those over 5 years, with the younger age group showing a higher prevalence of behavioral disorders, cerebral palsy, infections, sequelae, and developmental disorders. In terms of gender distribution, epilepsy emerged as the most common neurological disorder in both genders. However, significant gender-based differences were identified in epilepsy, headache disorders, neuroinflammatory disorders, neurocutaneous syndromes, behavioral disorders, cerebral palsy, and movement disorders [3].

Pediatric neurocritical care (PNCC) has significantly advanced over the past three decades. With declining mortality in pediatric critical care, the focus has shifted to addressing the increasing burden of neurodevelopmental morbidity. PNCC employs a multidisciplinary approach to identify neurological injuries promptly, apply neuroprotective strategies, reduce secondary neurological insults, and facilitate care transitions, aiming to enhance patients' neurocognitive outcomes [4].

The primary aim of this study is to analyze the demographic, clinical, and outcome data of pediatric patients with neurological disorders at Elshamal Specialized Hospital. Specifically, we will assess the relationships between demographic factors—such as sex, age, and residence—and treatment outcomes to identify potential areas for improvement in pediatric neurological care.

2. Methodology

A descriptive, retrospective, cross-sectional, and hospital-based study was conducted in Elshamal Specialized Hospital, Dongola, Northern State, Sudan. Elshamal Specialized Hospital serves as a healthcare facility in Northern Sudan, functioning as a referral center for pediatric neurology. With an estimated population of one million, predominantly consisting of children, understanding the prevalence and outcomes of neurological disorders within this demographic is vital for improving health services

The study aims to examine the demographic factors (sex, age, and residence) of pediatric patients with neurological disorders and assess the treatment outcomes for these patients at Elshamal Specialized Hospital. The study included 200 pediatric patients (aged 0-18 years) diagnosed with neurological disorders referred to the neurology clinic from the 1st. of December 2023 to the 1st. of October 2024 who accepted to participate in the study. Parents or caregivers who refused to participate were excluded from the study.

Data was collected from patients' files and hospital records including demographics (sex, age, residence), diagnosis, treatment received, and outcome (improved vs. not improved). The data obtained was coded, validated, and entered into a computer, and a master sheet was constructed to arrange and analyze the raw data. Ethical approval was obtained from the concerned administration. Consent was taken from parents or caregivers for both inclusion and sample collection after a clear explanation.

3. Results

The study encompassed 200 pediatric patients with neurological disorders, with a higher proportion of males (63.5%) than females (36.5%) [Table 1]. The majority of patients (80%) were aged 0 to 10 years, highlighting early childhood as a critical period for the onset of neurological disorders. Within this group, the age categories of 0–5 years and 5–10 years were nearly equal in representation. Patients aged 11–15 accounted for 16% (32), while those aged 15–18 made up 3.5% (7) [Table 2]. Geographically, 78% of the patients were from the North State, reflecting the hospital's status as a referral center, while 22% came from other regions [Table 3].

The diagnosis distribution among patients includes cerebral palsy (32%), epilepsy (29.5%), encephalitis (6%), autism (4%), psychosis (3.5%), head trauma (3%), cerebrovascular accident (2.5%), ADHD (2.5%), dyskinesia (2%), hydrocephalus (1.5%), Erb's palsy (2.5%), Arnold-Chiari malformation (1.5%), breath holding attack (1%), congenital myopathy (1%), sleep disorder (1%), and ataxia telangiectasia (0.5%) [Table 4].

Among the patients, 52.5% (105) achieved full recovery, 27.5% (55) showed ongoing improvement, and 19.5% (39) remained static, necessitating further assessment. The mortality rate was low, with one reported associated death (0.5%). Most patients presenting with epilepsy, cerebral palsy, encephalitis, and psychosis demonstrated improvement. In contrast, those with static conditions, including cerebral palsy, ataxia-telangiectasia, or congenital malformations, had varied outcomes. Notably, the greatest improvements were observed in patients with epilepsy with cerebral palsy or Arnold-Chiari malformation [Table 5].

One case involved a newborn diagnosed with congenital hydrocephalus at birth, who underwent shunt placement surgery. Post-surgery, the infant developed an intracranial hemorrhage and seizures that were unresponsive to intravenous phenytoin but improved with oral phenobarbitone. The child subsequently developed spasticity and pneumonia, ultimately passing away after four months of hospitalization despite medical interventions.

Table 1 shows the distribution of patients according to sex

Sex	**Male**	**Female**	**Total**
No. of Patients	127	73	200
Percentage	63.5%	36.5%	100%

Table 2 shows the distribution of patients according to age

Age	**0 – 5 Years**	**5 – 10 Years**	**11- 15 Years**	**Above 15Years**	**Total**
No. of Patients	80	81	32	7	200
Percentage	40 %	40.5%	16%	3.5%	100%

Table 3 shows the distribution of patients according to residence

Residence	**Northern State**	**Out of Northern State**	**Total**
No. of patients	156	44	200
Percentage	(78 %)	(22 %)	(100 %)

Table 4 shows the distribution of patients according to diagnosis

Diagnosis	Number	Percentage
CP	64	32 %
Epilepsy	59	29.5 %
Encephalitis	12	6 %
Autism	8	4 %
Psychosis	7	3.5
Head Trauma	6	3 %
Cerebrovascular Accident	5	2.5 %
ADHD	5	2.5 %
Dyskinesia	4	2 %
Hydrocephalus	3	1.5 %
Hydrocephalus	3	1.5 %
Erb's Palsy	5	2.5 %
Arnold Chair Malformation	3	1.5 %
Breath Holding Attack	2	1 %
Congenital Myopathy	2	1 %
Sleep Disorder	2	1 %
Ataxia Telangectasia	1	0.5 %
Spina Bifida	1	0.5 %
Concussion	1	0.5 %
Charcot Marie Tooth Disease	1	0.5%
Tics	1	0.5 %
Intension Tremors	1	0.5 %
Meningitis	2	1%
Total	200	100%

Table 5 shows the distribution of patients according to outcome

PROGNOSIS	NUMBER OF PATIENTS	PERCENTAGE
Improved	105	52.5 %
Improving	55	27.5 %
Static	39	19.5 %
Deaths	1	0.5 %
Total	200	100 %

4. Discussion

The findings from our study of pediatric neurological cases at Elshamal Specialized Hospital reveal critical insights into the demographic characteristics, prevalent diagnoses, and treatment outcomes of children with neurological disorders in Northern Sudan. The male-to-female ratio (approximately 1.7:1) observed in our sample is consistent with existing

literature that reports a higher prevalence of neurological conditions in males, particularly for disorders such as epilepsy, cerebral palsy, and developmental delay [5,6]. The age distribution of the patients highlights that the majority were between 0 and 10 years old, representing over 80% of the cases. This aligns with previous studies indicating that neurological disorders predominantly affect younger children, often due to factors such as congenital conditions, infections, and developmental disorders [5].

A significant majority of patients (78%) were from the Northern State, emphasizing the hospital's role as a regional referral center and reflecting disparities in healthcare access between urban and rural regions. This strong representation of local patients highlights the need for community health initiatives designed to address the specific needs of children in underserved areas.

Conditions such as cerebral palsy and epilepsy accounted for 32% and 29.5% of diagnoses, respectively. This is consistent with previous studies in Sudan by Mohamed IN et al., which identified childhood epilepsies, cerebral palsy, and developmental brain anomalies as the most common neurological disorders in clinics. In contrast, Frank-Briggs AI et al. reported that epilepsy and cerebral palsy, followed by central nervous system infections such as human immunodeficiency virus encephalitis, were the most common diagnoses. Additionally, some regions report higher incidences of central nervous system cysticercosis and tuberculosis, patterns not commonly observed in our population [6,7].

The observation that most pediatric patients with epilepsy, cerebral palsy, encephalitis, and psychosis showed improvement is consistent with findings in medical literature. For example, a study on pediatric epilepsy treatment outcomes revealed that 65.5% of children achieved favorable results with appropriate antiepileptic drug therapy. However, a significant proportion of pediatric epilepsy patients experienced poor treatment outcomes. To address this, healthcare providers must closely monitor treatment adherence, particularly in pediatric epileptic patients with poor compliance, a history of frequent seizures, head injuries, or those aged 11–15 years [8].

Most patients with epilepsy, cerebral palsy, encephalitis, and psychosis showed significant improvement, while those with static conditions like cerebral palsy, ataxia-telangiectasia, or congenital malformations had more varied outcomes. Notably, the greatest improvements were seen in patients with epilepsy linked to cerebral palsy or Arnold-Chiari malformation. Advancements in medical care have led to improved outcomes for many patients with epilepsy and CP. Early diagnosis and intervention, including the use of antiepileptic drugs and supportive therapies, have been associated with better prognoses. Epilepsy is common in individuals with cerebral palsy (CP), with studies indicating that approximately 15% to 30% of children with epilepsy also have CP [9].

The study highlights the presence of less common conditions like autism (4%) and psychosis (3.5%) among pediatric patients, emphasizing the need for comprehensive neurological evaluations. Such diversity in diagnoses underscores the importance of interdisciplinary care, where early diagnosis and timely interventions can significantly improve long-term outcomes for affected children. Early recognition of these conditions allows for targeted treatment, reducing the impact on developmental and psychological well-being. Diagnosis of autism is based on observations and interviews, as there are no objective diagnostic tools like blood tests or brain scans. Early diagnosis and intervention, typically before age three, are critical for improving skills through supportive measures such as speech therapy, occupational therapy, social skills training, and individualized education plans. Research indicates that early intervention can enhance developmental outcomes and improve adaptive skills [10]. Psychosis in children is characterized by a disconnection from reality, including hallucinations and delusions. Early diagnosis and intervention are crucial for improving long-term outcomes. A study found that children with first-episode psychosis and comorbid autism spectrum disorders at first presentation are less likely to have a beneficial response to treatment, highlighting the importance of early recognition and tailored interventions [11].

In cases of Chiari malformations, particularly in symptomatic children, surgical interventions like posterior fossa decompression have been effective in relieving pressure on the brain and spinal cord, leading to symptom improvement. A Park-Reeves Syringomyelia Research Consortium study compared posterior fossa decompression with and without duraplasty in pediatric patients with Chiari malformation type I and syringomyelia. The study found that both surgical techniques were effective in reducing syrinx size and improving symptoms, with duraplasty associated with a higher rate of complete syrinx resolution [12].

Historically, individuals with ataxia-telangiectasia (A-T) had a short life expectancy, but medical advances have increased it to about 25 years as of 2006. Chronic lung disease and cancer are the primary causes of death in A-T, each accounting for roughly one-third of cases [13].

Despite the challenges, the low mortality rate of 0.5% (1 patient) is encouraging. Overall, these results highlight the effectiveness of the treatment provided and underscore the importance of continuous assessment and adaptation of care strategies to enhance outcomes for all pediatric patients with neurological disorders. Moreover, it is important to consider the impact of the ongoing conflict in the region. Stressors related to displacement and healthcare disruptions can hinder treatment adherence and overall success.

4.1. Limitations

The study's limitations include a small sample size of 200 patients, dependence on retrospective data with possible inconsistencies, absence of long-term outcome tracking, and the impact of regional conflict on healthcare access and outcomes.

5. Conclusion

The study at Elshamal Specialized Hospital sheds light on the demographic characteristics, prevalent diagnoses, and treatment outcomes of Northern Sudan pediatric patients with neurological disorders. The higher incidence of these disorders among males and the predominance of cases in younger age groups underscore the urgent need for early intervention and tailored healthcare strategies. Notably, the significant proportion of patients who showed improvement post-treatment highlights the potential effectiveness of current interventions, despite challenges posed by regional conflict and healthcare access issues.

Recommendations

Recommendations include enhancing early diagnosis through screening programs, raising awareness in rural communities, providing continuous training for healthcare providers, promoting multidisciplinary care, conducting longitudinal research, and integrating mental health services into pediatric care, especially in conflict-affected regions.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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