

Advances in Neurosurgery for Pediatric Patients and Evaluate Health Outcomes

Dr. Abdulqadder Nabil Mohammed

M.B.Ch.B., F.I.B.M.S., F.W.F.N.S. \ (Neurosurgery), Fellow members of World Federation of Neurosurgical Societies, Iraqi Ministry of Health, Baghuba Health Department, Baghuba Teaching Hospital, Neurosurgery Unit, Baghuba, Iraq

Dr. Firas Jebbar

M.B.Ch.B., F.I.B.M.S. \ (Neurosurgery), Iraqi Ministry of Health, Baghuba Health Department, Baghuba Teaching Hospital, Baghuba, Iraq

Dr. Haidar Karim Hussein

M.B.Ch.B., F.I.B.M.S., C.A.B.N.S (Neurosurgery), Iraqi Ministry of Health, Baghdad Al-Rusafa Health Directorate, Dr. Saad Al-Witry Hospital for Neurosciences, Baghdad, Iraq

Dr. Ali Qais Abdulkafi

M.B.Ch.B., D.C.H. (Pediatrics), Iraqi Ministry of Health, Kirkuk Health Department, Kirkuk Teaching Hospital, Kirkuk, Iraq

Abstract: Background: Neurological disorders constitute approximately 30% of all diseases globally, with a significant majority prevalent in developing nations. Aim: This study focuses on assessing the health-related quality of life (HRQoL) in pediatric patients subjected to neurosurgery. Methods: Clinical data were procured from different hospitals in Iraq during the period between July 14th, 2022, and August 18th, 2023, involving both pediatric and adult patients undergoing neurosurgery. The study encompassed 67 patients with an age range of 2 to 13 years. The data included test results and identified etiology in children.

Additionally, it accounted for anesthetic outcomes for additives such as remifentanyl, sevoflurane, and propofol. The HRQoL scale was employed to evaluate the health-related quality of life in pediatric patients post-surgery, focusing on physical, mental, emotional, and social functions. Results: Demographic data indicated a higher male population (41 patients) compared to females (26 patients). The clinical data recorded included the duration of surgery, anesthesia, estimated blood loss during surgery, and postoperative complications. The surgery lasted 342.57 ± 12.1 minutes, the anesthesia duration was 318.41 ± 100.50 minutes, and the estimated blood loss was 110.5 ± 71.2 ml. Postoperative complications were recorded in 21 cases, predominantly involving infection and bleeding. The average hospital stay was 9.1 ± 3.5 days, with a follow-up period of 10 months. The recovery period spanned between 6 to 10 weeks, and there were five recorded fatalities. The HRQoL assessment revealed physical functions at 76.8, mental functions at 60, emotional functions at 71.33, and social functions at 57.35. Conclusion: This study validates the effectiveness of meticulous surgical procedure management in preserving the quality of life for pediatric patients across diverse age groups. It also highlights the postoperative

complication rate, with infection and bleeding being the most prevalent. The mortality rate was less than 6%, reflecting the overall patient outcomes.

Keywords: Neurosurgery; Pediatric Patients; Post-Complications; Quality of Life.

Introduction

Neurosurgery, often referred to as neurological surgery, is a specialized branch of medicine that encompasses the identification, therapeutic approach, and surgical intervention of ailments afflicting the nervous system, inclusive of the brain, spinal cord, and peripheral nerves [1]. Neurosurgeons, who are highly skilled medical practitioners, employ surgical methodologies to counteract a wide array of conditions that assail the nervous system [2].

Presently, the field of pediatric neurosurgery is witnessing the emergence of novel trends such as the handling of venous thromboembolism (VTE) [3], and suitable perioperative management, and concerted efforts to augment pediatric neurosurgical care in low- and middle-income countries (LMICs). Moreover, there is a strong emphasis on the invention of safer, less invasive procedures and the provision of expedited care for pediatric patients with acute neurosurgical conditions. [4,5]

In the context of VTE management, the use of low molecular weight heparin (LMWH) is deemed safe and efficacious for pediatric patients at risk [6]. Perioperative management necessitates the computation of fluid needs, the utilization of isotonic electrolyte solutions, and the prescription of prophylactic antibiotics and antiepileptic medications [7]. Meanwhile, the improvement of pediatric neurosurgical care in LMICs primarily revolves around the management of hydrocephalus and medical pedagogy. Endoscopic third ventriculostomy is gaining traction as a potent alternative to ventriculoperitoneal shunting. The drive towards safer and less invasive procedures is fueled by advancements in neuroimaging and the imperative for procedural refinement. [8]

Pediatric neurosurgery involves a delicate balance between risks and benefits. Potential risks encompass complications related to anesthesia, hemodynamic, respiratory, and neurological fluctuations post-surgery, and the necessity for frequent evaluations in a critical care environment [9]. Patient safety incidents can transpire in pediatric neurosurgery nursing; proactive measures, such as the scrutiny of safety incidents, identification of their root causes, and implementation of appropriate corrective actions, can mitigate their incidence. Conversely, pediatric neurosurgery also presents significant benefits. [10]

Progress in surgical techniques, knowledge base, and expertise has facilitated successful outcomes in intricate procedures like awake craniotomy, interventional neuroradiology, minimally invasive neurosurgery [11], operations in intraoperative magnetic resonance imaging suites, and neonatal emergencies. Anesthesiologists play a pivotal role in postoperative recovery by managing factors [12] as well as. Despite the inherent risks, pediatric neurosurgery holds the promise of enhancing patient outcomes and ensuring the effective treatment of neurosurgical cases in children [13].

Patients and method

In the time span between July 14th, 2022, and August 18th, 2023, a comprehensive cross-sectional investigation was carried out on pediatric patients aged 2 to 13 years who underwent neurosurgical procedures in different hospitals in Iraq. The study was primarily focused on collecting and analyzing clinical data from these pediatric cases.

The demographic information collected encompassed factors such as age, sex, and presenting symptoms. The study was diagnosed and analyzed a range of diseases where these young patients were suffering from. The illnesses observed was also included conditions like shunt,

myelomeningocele, hydrocephalus, conus lipoma, tumors, post-fossa tumors, trauma, encephalocele, and among others.

In addition to the diagnosis, the study meticulously recorded the patients' intraoperative data where, this encompassed details such as the duration of surgery, the length of anesthesia administered, and vital signs like heart rate and systolic and diastolic blood pressure. The study also evaluated the effects of anesthesia additives in terms of remifentanyl, sevoflurane, and propofol.

Postoperative outcomes were captured, including postoperative complications, the length of the hospital stay, patient follow-up, recovery period, and mortality rate. This study assessed the quality of life of pediatric patients after surgery using the health-related Quality of Life (HRQoL) scale. This scale included basic measures of physical, mental, emotional, and social functions within a range of 0 to 100, with 100 symbolizing the highest value and 0 the lowest.

The study also gauged patient satisfaction with the quality of central care in managing the surgical procedure. The results were measured within criteria that included excellent, good, and poor ratings. The collected clinical data was then organized and analyzed at a p-value of less than 0.05. The clinical results related to the health quality of life after neurosurgery and brain surgery for pediatric patients were analyzed using the SPSS program, version 22.0.

Results

Variables [n=67]	N [%]
Age	
2-5	21 [31.34%]
6-9	22 [32.84%]
10-13	24 [35.82%]
Gender	
Males	41 [61.19%]
Females	26 [38.81%]
Symptoms	
Headache	24 [35.82%]
Seizures	18 [26.87%]
Vision or hearing problems	13 [19.40%]
Developmental delays	12 [17.91%]

Variables [n=67]	N [%]
Shunt	14 [20.9%]
Myelomeningocele	12 [17.91%]
Hydrocephalus	10 [14.93%]
Conus lipoma	8 [11.94%]
Tumor	7 [10.45%]
Tumor post fossa	5 [7.46%]
Trauma	4 [5.97%]
Encephalocele	4 [5.97%]
Other	3 [4.48%]

Table 3: Neurosurgery outcomes for pediatric patients.	
Variables [n=67]	Outcomes
Operative time [min], (mean ± SD)	342.57 ± 12.1
Duration of anesthesia [min], (mean ± SD)	318.41 ± 100.50
Propofol (mg), (mean ± SD)	3.2 ± 1.4
Remifentanyl (mg), (mean ± SD)	0.65 ± 0.33
Sevoflurane (ml), (mean ± SD)	34.2 ± 14.67
Bleeding (ml), (mean ± SD)	110.5 ± 71.2
Blood transfusion, N [%]	16 [23.88%]
Heart rate	92.10 ± 14.6
Systolic blood pressure [mm Hg], (mean ± SD)	108 ± 20.64
Diastolic blood pressure [mm Hg], (mean ± SD)	74 ± 11.55

Table 4: Post-operative findings.	
Variables [n=67]	Outcomes
Complications, N [%]	
Infection	7 [10.45%]
Bleeding	5 [7.46%]
Cerebrospinal fluid (CSF) leakage	3 [4.48%]
Developmental Delays	2 [2.99%]
Hydrocephalus	4 [5.97%]
Length of stay [Days], (mean ± SD)	9.1 ± 3.5
Follow-up [months], (mean ± SD)	8.2 ± 2.6
Recovery time [weeks], (mean ± SD)	8.24 ± 2.6
Satisfaction level, N [%]	
Excellent	28 [41.79%]
Good	24 [35.82%]
Poor	15 [22.39%]
Mortality rate	4 [5.97%]

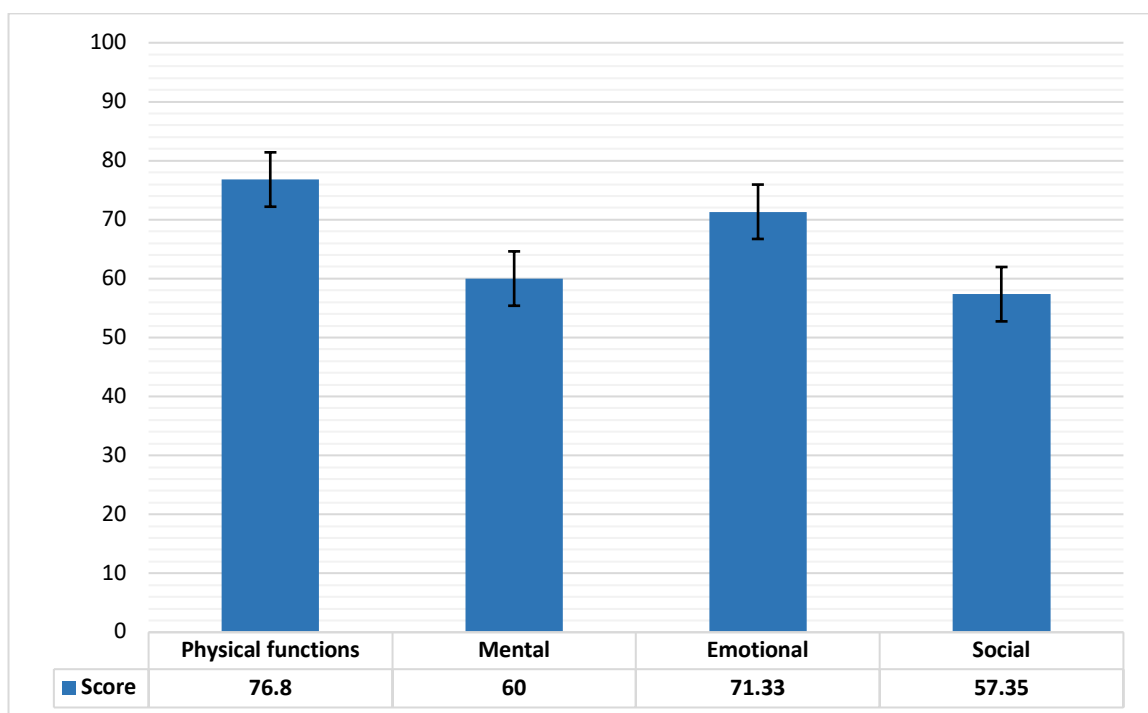


Fig 1: Assessment of Health-Related Quality of Life by HRQoL scale.

Discussion

In the study under review, a total of 67 pediatric patients were examined, with a preponderance of male patients (41) over female patients (26). The most frequently reported symptoms in this study were headaches, with 24 instances, followed by seizures, reported in 18 cases, and these symptoms were found to be the most prevalent amongst pediatric patients.

As part of their treatment, the pediatric patients underwent neurosurgery, and the resultant diagnoses were considered as follows: 14 instances of Shunt, 12 cases of myelomeningocele, and 10 cases of hydrocephalus. Besides to that, the surgical outcomes were measured, with the average surgery duration being approximately 342.57 minutes, plus or minus 12.1 minutes. The average anesthesia duration was detected to be roughly 318.41 minutes, with a standard deviation of 100.50 minutes.

In addition, certain materials were administered to pediatric patients, which include propofol (average dosage of 3.2 mg, plus or minus 1.4 mg), Remifentanyl (average dosage of 0.65 mg, plus or minus 0.33 mg), and sevoflurane (average dosage of 34.2 mg, plus or minus 14.67 mg). The estimated average blood loss during these procedures was 110.5 ml, with a standard deviation of 71.2 ml, and there were 16 instances where blood transfusion was necessary.

Vital signs were also monitored, with the average heart rate measured at 92.10 beats per minute (plus or minus 14.6), diastolic blood pressure recorded at 74 mm Hg (plus or minus 11.55), and systolic blood pressure recorded at 108 mm Hg (plus or minus 20.64).

Postoperative data indicated that there were 21 instances of complications, most notably infections and bleeding. The average length of hospital stay post-operation was approximately 9.1 days, with a standard deviation of 3.5 days. The average recovery period was between 6 to 10 weeks, and there were four recorded cases of mortality. Patient satisfaction was also gauged, with 28 instances of excellent satisfaction, 24 of good satisfaction, and 15 of poor satisfaction. Furthermore, the health-related quality of life (HRQoL) was assessed for pediatric patients who underwent neurosurgery. Physical functions were scored at 76.8, Mental at 60, Emotional at 71.33, and Social at 57.35.

American study was showed that Insurance status is significantly associated with mortality, length of stay, and favorable discharge disposition among pediatric neurosurgery trauma patients where Pediatric neurosurgical procedures have low perioperative mortality but high morbidity rates, which emphasizing the need for targeted quality improvement programs and interventions as well as insurance status and hospital ownership type impact outcomes for pediatric patients undergoing neurosurgical treatment for spasticity and with Medicaid patients having longer hospital stays and free-standing children's hospitals showing better discharge dispositions. [14,15]

Other studies were indicated that factors that influence the quality of life of pediatric patients after neurosurgery include the perceptions of parents and patients, the impact of the illness, and the presence of risk factors where parents often have more negative assessments of their children's health-related quality of life (HRQoL) compared to their children themselves [16], as well as brain tumor, a common condition in pediatric neurosurgery, has been found to have a major impact on children's quality of life, with risk factors including tumor location, radiation, hydrocephalus, lower IQ, and behavioral problems. [17]

French study was found that factors that contribute to a good quality of life for pediatric patients after neurosurgery include understanding parents' perceptions of their children's health-related quality of life (HRQoL) [18] as well as the use of validated HRQOL instruments is important in assessing outcomes and monitoring progress and Intraoperative neurophysiological monitoring and maximal tumor removal with minimal neurological morbidity are crucial in minimizing postoperative complications and preserving quality of life. [19,20]

Conclusion

In conclusion, this study highlighted an increased risk associated with neurosurgery for males compared to females. It documented the meticulous management of the surgical procedure and underscored the commitment to maintaining the patient's quality of life across diverse age groups. Postoperative complications were primarily infections and bleeding, with a mortality rate of less than 6%. Central care demonstrated effective success in executing neurosurgery with high precision, concurrently preserving the quality of life of the pediatric patients. Based on the HRQoL scale, physical and emotional aspects were noted to be excellent and effective post-operation.

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