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Nutritional Management of Children With Viral Encephalitis, Hydrocephalus Communicans, Sepsis, Status Epilepticus : Case Study

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ABSTRACT

This case study examines the impact of nutritional management in a pediatric patient with complex neurological conditions, including viral encephalitis, hydrocephalus, sepsis, and status epilepticus. A 10-day comprehensive nutritional care process (NCP) was implemented, involving screening, assessment, diagnosis, intervention, monitoring, and evaluation. The patient was at high risk of malnutrition, with diagnoses in Nutrition Intake, Clinical, and Behaviour domains. Anthropometric measurements indicated underweight status, while biochemical exams revealed risks of anemia and hyponatremia. Nutritional intervention via a modified ketogenic diet showed improved enteral feeding intake and feeding practices after continuous nutrition education and counseling. Individualized nutrition management effectively prevented further muscle mass loss and improved caregiver feeding practices.

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Key Messages:

- This study highlights the importance of nutritional management in patients with neurological complications through an individualised approach using a Nutritional Care Process (NCP) consisting of nutritional screening, nutritional assessment, nutritional diagnosis, nutritional intervention, and nutritional monitoring and evaluation.
- The objectives of nutritional intervention in NCP include gradually increasing patients' enteral intake, preventing further muscle mass loss, and improving feeding practices for patients.

INTRODUCTION

Viral encephalitis is an inflammation of brain tissue due to viral infection, which can cause impaired neuronal function. One of its complications is communicant hydrocephalus (1). The incidence of viral encephalitis ranges from 3.5 to 7.5 per 100,000 people per year, with the highest incidence in children (2). This is due to congenital cytomegalovirus (CMV) infection whose prevalence of 20-30% can have long-term complications such as developmental delay (3) and congenital Toxoplasmosis with an average of about 15 cases per 10,000 live births (4). The presence of encephalitis that causes hydrocephalus can be treated with External Ventricular Drainage (EVD), a temporary surgical procedure to drain CSF from the brain ventricles to the external system to reduce intracranial pressure (5) and the installation of a VP shunt (ventriculoperitoneal shunt) (1).

Pseudomonas aeruginosa is the third most common cause of bloodstream infections due to Gram-negative bacteria that can cause sepsis, with a mortality rate of up to 30% within 30 days (6). In a retrospective study, the incidence of P. aeruginosa bacteremia in children was 33.9 per 100,000 hospitalisation days, with 91.8% of cases related to healthcare (7). Status epilepticus (SE) is a common neurological emergency in children, with an annual incidence of approximately 10-27 cases per 100,000 children, highest in children under 1 year of age (8). SE can cause decreased consciousness and a weak cough reflex, resulting in respiratory complications, including sputum retention, especially in prolonged or refractory cases (9).

Advanced complications from these diseases can lead to Community Acquired Pneumonia (CAP), a leading cause of

infectious death in children worldwide. In 2019, pneumonia caused the deaths of 740,180 children under 5 years of age, accounting for 14% of all deaths in that age group (10). In developing countries, the incidence of CAP in children under 5 years old reaches 260 per 1,000 children per year, while in developed countries it is around 30-40 per 1,000 children (11).

These neurological complications have a significant impact on nutritional status including the risk of stunting and malnutrition in children. Chronic malnutrition and stunting significantly affect children's neurological and cognitive development and reduce resistance to infection (12). A Ugandan study reported a 31 % wasting prevalence in children under 5 years with hydrocephalus associated with impaired oral intake, respiratory distress, and infections that reduce nutrient intake (13). A study in Ethiopia reported that 60% of children with epilepsy were malnourished (stunting and wasting), associated with feeding difficulties and the use of antiepileptic drugs (14). According to WHO (2024) and ESPGHAN (2023), enteral feeding strategies should be adjusted based on neurological status and gastrointestinal tolerance (15, 16).

This case study contributes a distinctive perspective to pediatric nutrition therapy by focusing on individualized intervention strategies in complex neuroinfectious conditions. This study aims to assess the effect of nutritional management in pediatric patients with diagnoses of viral encephalitis, hydrocephalus communicans, sepsis, and status epilepticus in a comprehensive nutritional care process (NCP). Nutritional monitoring and dietary adjustments were conducted daily over a 10- day hospitalization period.

CASE DESCRIPTION

A child (An.K) aged 4 years 10 months (58 months) male was admitted to the Pediatric Intensive Care Unit (PICU) of Wahidin Sudirohusodo General Hospital Makassar. Previously the patient was treated for 21 days at UNHAS Hospital, then referred to Wahidin Sudirohusodo Hospital with a medical diagnosis of post-convulsive seizure et causa (ec) status epilepticus and brain oedema, acute respiratory distress syndrome (ARDS) and gastrointestinal bleeding. Previous medical history is attention deficit/hyperactivity disorder (ADHD), a history of low birth weight (LBW) which is 2100 g and has an allergic reaction to PRC transfusion. At the time of data collection (March 08, 2025) the patient's medical diagnoses were POH-3 VP-Shunt installation ec viral encephalitis, POH-6 EVD ec hydrocephalus communicans, sepsis ec Pseudomonas aeruginosa, CAP, sputum retention ec status epilepticus, CMW infection, and Toxoplasma infection. The patient is the first child of 2 siblings, living with family (father, mother and grandmother).

At the time of nutritional assessment, the patient was on total bed rest with the results of anthropometric measurements at the time of initial admission, namely body weight (BW) 14 kg, body length (PB) 106 cm, Mid upper arm circumference (MUAC) 14 cm with the interpretation of nutritional status from the index of Hight for Age Z score (HAZ) and Weigh Hight Z score (WHZ), classified as normal. After re-measurement at the time of nutritional assessment, the results of MUAC were obtained 13 cm, PB 106 cm, the mother said there was a decrease in BW but the amount was unknown, so that the interpretation of nutritional status based on the percentage of MUAC 76% was classified as undernourished and a decrease in MUAC showed hemoglobin, hematocrit, erythrocytes, lymphocytes, and sodium values decreased but not significantly and thorax photos showed bilateral pneumonia (Table 1).

The general condition was severe pain (decreased consciousness), accompanied by tightness and mucus, constipation since 3 days after surgery. The patient had urination via catheter (1382.6 ml/24 hours), blood pressure 90/60 mmHg, temperature 36.5^{0}C, respiration 32x/min, pulse 116x/min and SpO2 98%. Physical nutrition focus showed biceps fat loss and arm muscle wasting (Table 2). The patient's eating habits before the illness were the staple food of rice 4-6 times/day (1/4 bag of rice), animal side dishes every day fish (1/4 piece mixed with rice), did not like vegetable side dishes and vegetables, liked consumption of snack crackers (2- 3 packs/day) and packaged milk (2-3 times/day). Breastfeeding history was only 1 week due to LBW condition so formula milk was given from the age of 2 weeks to 4 years 9 months. The patient's mother had previously been exposed to limited nutrition information from health workers and social media.

At the time of the assessment, the diet order given to the patient was commercial enteral nutrition (NE) liquid diet (*pedia-com milk*) 8 x 60 cc via nasogastric tube (NGT) and parenteral nutrition (NP) 5% dextrose 858 cc/24 hours. The total percentages of NE and NP intake were energy 96.5%; protein and fat 62.5% each; KH 129.7%; and vitamin C, iron, sodium and fibre 62.5% each. During the last 1-2 months of hospitalisation, the patient was given the same commercial liquid diet, with various volume variations (60 - 210 cc with 8 administrations) and sometimes stopped NE intake in case of tightness and surgery. The medications prescribed to the patient were dextrose 5% 45cc/hr/iv, ceftriaxone 1.5 g/24 hr/iv, midazolam 2 mcg/kg BW/sp, acitelsistein 70 mg/8 hr/orally, cetirizine 5 mg/24 hr/orally, phenobarbital 8 mg/kg BW/iv and dexamethasone 5 g/24 hr/iv

RESULTS

Establishment of nutritional diagnoses including Nutrition Intake (NI) domain, namely NI-2.11 limited food intake related to neurological disorders characterized bymalnutrition status based on limited beverage intake (especially protein and fat), and conditions related to medical diagnosis; Nutrition Clinical (NC) domain, namely NC-4.1 poor nutritional status related to increased energy needs due to prolonged catabolic disease is characterized by nutritional status based on the percentage of MUAC 76%, wasting due to a decrease in MUAC size of 1 cm in the last 2 months, and a history of LBW and ADHD; and the Nutrition Behavior (NB) domain, namely NB-1.1 lack of knowledge related to food and nutrition related to receiving limited nutrition education is characterized by the child's irregular diet (only eating fish and rice, predominantly given formula milk and likes to consume snacks and packaged milk).The nutritional intervention plan was a modified ketogenic diet. The objectives of the intervention included helping to increase adequate NE intake by gradually providing a high-fat formula to prevent recurrent seizures; helping to prevent further muscle mass loss to gradually increase the size of MUAC to normal; and helping to improve the patient's mother's nutritional knowledge and quality of life through nutrition education and counseling. The principle of the diet given is a high fat and low KH diet, with conditions including energy given using the Recommended Dietary Allowance (RDA) which is 1448.2 kcal; protein 30.9 g; fat 66.7 g preferably medium chain fat (MCT); Carbohydrate (CH) 181 g; fiber 20 g; liquid 1225 ml/day; vitamin C 45 mg; iron 10 mg and sodium 900 mg/day. The form of food given is liquid via NGT with 8 times of administration (06.00, 09.00, 12.00, 15.00, 18.00, 21.00, 00.00 and 03.00 local time).

Table 1. Details of the Daily Enteral Nutrition (EN) Schedule

Day	NE Formula	Energy (kcal)	Protein (g)	Fat (g)	CH (g)	Fiber (g)	Vit.C (mg)	Fe (mg)	Sodium (mg)
1-2	Formula Milk 8 X 90 cc	720	21.7	28.8	95.6	3.2	58	8	273
3	Formula Milk 8 X 90 cc + VCO 3 X 5 cc	855	21.7	43.8	95.6	3.2	58	8	273
4-6	Formula Milk 8 X 100 cc + VCO 3 X 5 cc	935	24.1	47	106	3.6	64	8.9	304
7	Formula Milk 8 X 120 cc + VCO 3 X 5 cc	1095	28.9	53,4	127	4.3	77	10	364
8	Formula Milk 8 X 120 cc + VCO 4 X 5 cc	1140	28,9	58.4	127	4.3	77	10	364
9	Formula Milk 8 X 150 cc + VCO 5 X 5 cc	1425	36.2	73	159	5,1	97	13	456
10	Formula Milk 8 X 120 cc + VCO 4 X 5 cc	1140	28.9	58.4	127	4.3	77	10	364

Table 2. Results of Monitoring and Evaluation of Biochemical Values

Parameter	**Before**	**During Intervention**		Reference Value	Interpretation
	08/04/2025	09/04/2 025 (follow-up examination)	10-18 /04/2025 (no present)		
Thorax photo	Pneumonia Bilateral	-	-	None	Bilateral Pneumonia
BD-1.10.1 HGB	11,0	11,9	-	12-16 g/dl	Risk of Anemia
BD-1.10.2 HCT	32	37	-	37-48%	Normal
BD-1.10.5 RBC	3,92	4,47	-	4 – 6 $x10^6$/UL	Normal
BD-1.2 Natrium	132	-	-	135-145 mmol/L	Risk of Hyponatremia

BD= biochemical data; HGB= haemoglobin; RBC= red blood cell; HTC= hematocrit

The results of nutritional screening in this patient showed a high risk of malnutrition and a special condition with severe neurological disease. The standardised nutritional care process (NCP) was carried out during 4 days of intervention at Wahidin Sudirohusodo Hospital and 6 days of home visit intervention. During the 10 days of intervention, anthropometric measurements were taken at the time of assessment, day 5 and day 10 with the result that there was no

change in the size of MUAC and Height in children so that their nutritional status remained in the deficient category. Laboratory examinations during the intervention were recorded at assessment and day 2 of the intervention (Table 2). The results of the physical monitoring and evaluation of the patient's nutritional focus were observed and recorded from the electronic medical record results during hospitalisation for 4 days and observed during 6 days of home visits in Table 3:

Table 3. Results of Monitoring and Evaluation of Physical Nutrition Focus

Parameter Terminology NCP	**Before** 08/04/2025	**During** 09-12/04/2025 (intervention phase in hospital)	13-18/04/2025 (intervention phase in home)	**Reference Value**	**Interpreta tion**
PD-1.1.9 Vital Signs					
Blood Pressure	90/60	120/80*	-	90-110/55-75 mmHg	Normal
Temperature	36,5	36,5		36,5-37,5 ºC	
SpO2	98	98-99		95-100%	
Respiration	32	21		20-30x/min	80-120x/min
Pulse	90	81-85			
PD-1 Physical Nutrition Focus					
PD.1.1.1 General Condition	Severe Pain (Shortness of breath)	Severely ill (Shortness of breath, spontaneous eye opening)	Moderately ill (minimal mobilisation)	Good	Moderately ill
PD-1.1.4.5 Dyspneu	Yes	Not present	Not present	Not present	No shortness of breath
PD-1.1.5 Gastrointestina l tract	No nausea & vomiting	There is 1x loose stool**	There is nausea and vomiting***	Not present	Disturbance present
PD-1.1.5.6 Anorexia	Present for the last 2 months	Yes	Yes	Not present	Anorexia
PD-1.1.5.9 Constipation	Present for the last 3 days	Not present	Not present	Not present	Not constipated
PD-1.1.2.3 Loss of biceps fat and arm muscle	Available	Available	Available	Not present	*Wasting*

*measured on day 1 of intervention; **reported on day 3, 4, 6;***reported on the 9th day of intervention; *measured on day 1 of intervention; **reported on day 3, 4, 6;***reported on the 9th day of intervention; PD= Physical Domain; SpO_2 or Peripheral Oxygen Saturatio

In addition to food and nutrient intake, the interaction of drugs given such as ceftriaxone, midazolam, acitelsistein, phenobarbital and dexamethasone has a mechanism that will inhibit the absorption of nutrients in the digestive tract, especially micronutrients, namely calcium and vitamin D. The results of monitoring and evaluation of nutrition education and counseling to patient's mother showed that there was an improvement in feeding practices for children both in terms of increasing the volume of NE and Virgin Coconut Oil (VCO) gradually and adherence to the updated NE feeding schedule to minimize missed meals by the patient's mother. Thus, recommendations were given regarding the continuation of the diet gradually until it reached≥ 80% of the RDA requirement

DISCUSSION

The results of anthropometric measurements of patients measured using MUAC showed a decrease of 1 cm after a nutritional assessment in a span of almost 2 months. This is due to prolonged catabolic disease conditions that increase the need for energy and nutrients, food/beverage restrictions during hospitalisation in the PICU and length of hospitalisation. In the acute phase of critical illness, the body undergoes high metabolic stress, triggering increased protein catabolism to meet energy demands and glucose synthesis. This process leads to degradation of muscle proteins, including the muscles in the upper arm, which contributes to decreased LLA. Factors such as immobilisation, systemic inflammation, and inadequate nutrient intake exacerbate this loss of muscle mass. (17)

Improvement in clinical markers such as reduced vomiting and stabilized body temperature were observed following increased protein and iron intake. In addition, Table 2 and Graph 1 show correlates daily iron and protein intake values with corresponding hemoglobin measurements over the intervention period. Protein supports enzyme synthesis

critical to neurotransmission recovery, while iron acts as a cofactor in neural oxygenation.

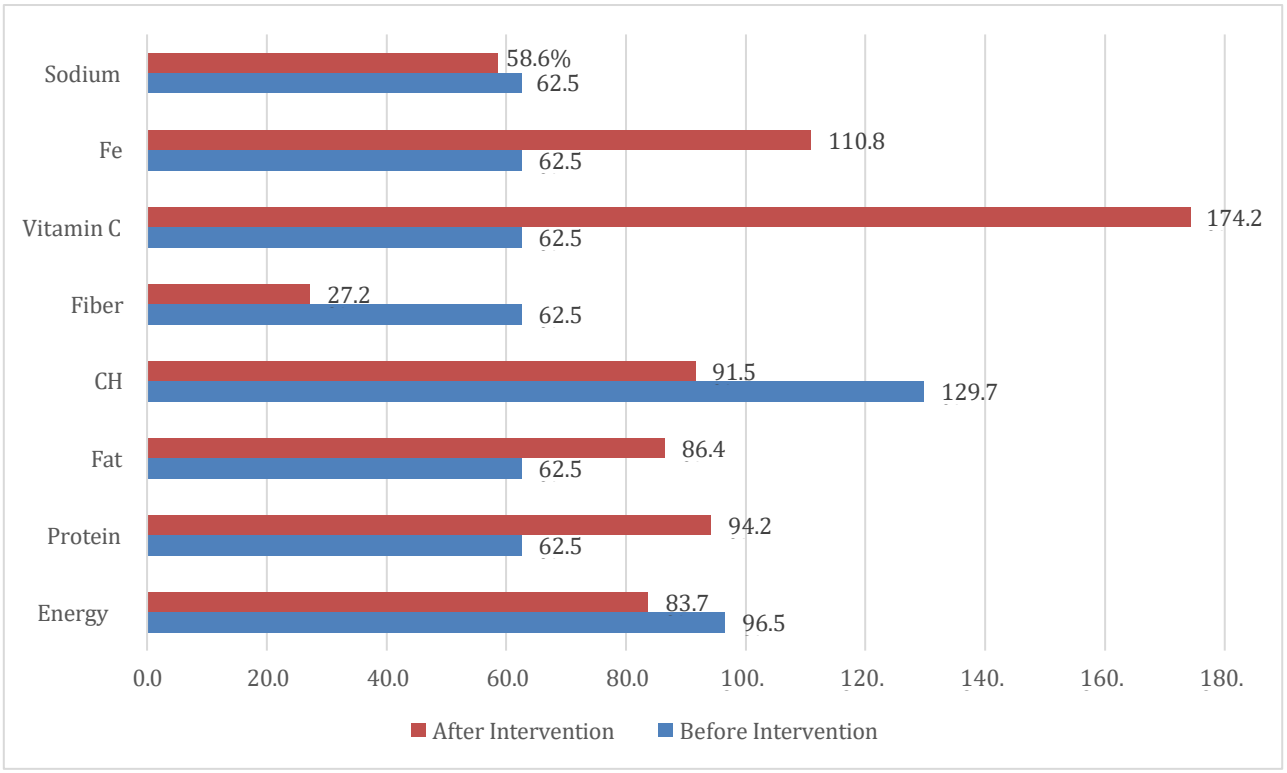

Figure 1. Monitoring evaluation Intake Before and After Intervention

The results of monitoring and evaluation of patient energy intake for 10 days of intervention based on 24-hour recall compared with the needs gradually starting from the actual needs when in the PICU (day1), 50% RDA needs (day 2), 60% RDA needs (day 3), 70% RDA needs (days 4, 5 and 6), 80% RDA needs (days 7, 8 and 10) and 100% RDA needs (day 9). In addition, the results of dietary intervention showed that iron intake illustrated a progressive increase in hemoglobin levels (Table 3 and Graph 1)

Ketogenic diets have been explored as a treatment option for status epilepticus in pediatric patients (18). This is in line with the dietary prescription given to patients during the implementation of nutritional interventions. Calculation of fat requirements in the administration of VCO-enriched commercial enteral formulas in children with status epilepticus should be individualised, with close monitoring of clinical response and patient tolerance in order to achieve stable ketosis to control seizures, ensure energy and growth requirements are met (19).

The results of patient intake after the intervention on average experienced a positive change when compared to before the intervention (moderate category). The data showed a significant increase in protein and fat intake of almost 1.5 times and 1.4 times from before the intervention. Meanwhile, energy and KH intake decreased by almost 1.2 times and 1.4 times from before the intervention (but still within the 80% RDA target). Recent studies such as Marino et al. (2020); Dermikol et al. and Briassoulis et al., provide insights into micronutrient therapy in pediatric intensive care (20-22). Iron facilitates hematologic recovery through its role in erythropoiesis, while protein supports immune response and tissue repair during the neuroinflammatory phase.

The significant decrease in energy and KH intake was due to the reduction in NP D5% provided. This is supported by a study from Lin and Wang (2020) which states that patients with status epilepticus, especially those undergoing ketogenic diet therapy, reduction or discontinuation of D5% is necessary to achieve effective ketosis and in the intravenous ketogenic diet protocol, D5% administration is gradually reduced (23). The increase in fat intake was significant compared to before the intervention due to the gradual addition of VCO given along with NE. A study showed that MCT supplementation can help manage drug-resistant epilepsy, with a 42% reduction in range after three months of supplementation (24).

The ketogenic diet requires an in-depth understanding from the family regarding nutrient management. This education aims to ensure the success of therapy and prevent complications that may arise due to ignorance or errors in dietary management. Research by Faradilah et al (2022) shows that ongoing nutrition education to families, including growth-promoting diet planning and nutritional status monitoring, is essential to prevent relapse and ensure optimal recovery. Active family involvement in diet planning and implementation has been shown to improve patient satisfaction and clinical outcomes (25).

Nutritional interventions in the acute phase are critical as patients are prone to acute malnutrition, high catabolism, and long-term risks such as stunting if not optimally managed. Complications of severe neurological diseases contribute to stunting through several mechanisms including decreased food intake, increased metabolic

demand, and drug-induced metabolic disturbances (26). The developmental implications of these disease complications not only interfere with long-term growth that correlates with stunting, but also go beyond the immediate effects, namely developmental disorders in children including cognitive, behavioural and psychosocial domains (27).

The results of nutritional screening, follow-up laboratory investigations, physical Data on nutritional focus, micronutrient intake and drug-nutrient interactions during the intervention were reported in this study but not elaborated further in the discussion. This case study lacked long-term follow-up, which limits conclusions regarding sustained nutritional outcomes.

CONCLUSION

Based on the case description, an individualised nutritional management approach was shown to increase the patient's adequate enteral intake which prevented further muscle mass loss during the intervention and improved feeding practices by the patient's mother.

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