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# Standardized Nutritional Care for Children with Moderate Tetanus


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## ABSTRACT

Tetanus in children is a preventable neuromuscular infection that continues to occur due to delayed immunization. This case study documents an individualized nutritional intervention for a pediatric tetanus patient at Dr. Wahidin Sudirohusodo Hospital. Over a 7-day period, standardized nutritional care (NCP) was implemented, covering assessment, diagnosis, intervention, and monitoring. Results demonstrated increased energy intake—from 40% to 100% of daily requirements—alongside a rise in mid-upper arm circumference from 14.5 cm to 15 cm. Improvements were also noted in the mother's feeding practices. A modified ketogenic diet effectively supported recovery by preventing muscle mass loss and addressing neurological complications. Nutrition education enhanced family understanding of feeding techniques. The findings reinforce the value of personalized nutritional care in managing tetanus with coexisting malnutrition, offering insights for clinical practice and nutrition policy.



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**CASE REPORTS**

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## Key Message

- Individualized nutritional care using a standardized approach NCP can significantly improve energy intake and prevent muscle loss in children with moderate tetanus.
- Nutrition education for caregivers plays a crucial role in enhancing feeding practices and sustaining recovery beyond hospitalization.

## INTRODUCTION

Tetanus is an acute infectious disease caused by Clostridium tetani exotoxin, tetanospasmin, which is neurotoxic and causes neuromuscular disorders in the form of progressive muscle spasm (1). The high number of tetanus cases in children occurs due to the low coverage of Tetanus Toxoid (TT) immunization in mothers during pregnancy (2). The World Health Organization (WHO) states that although tetanus can be prevented through immunization, the annual mortality rate due to neonatal tetanus is still significant, especially in areas with weak immunization systems (3). Nationally, immunization coverage is still not reaching the target, with only about 84% of children receiving complete basic immunization. Meanwhile, TT immunization achievement was only recorded at 77.6%, and in South Sulawesi, it was 88.7% (4).

Research conducted by Rampengan, N.H., et al. showed that out of 40 children admitted with a diagnosis of tetanus during the period 2002-2012, 45% of them had never received tetanus immunization (5). Similar findings were reported by Yusufina in a case study at RSUD Langsa Aceh, who noted that a child with tetanus also did not receive complete DPT immunization (6). Delayed immunization is a major contributing factor that results in children not having protective immunity against Clostridium tetani toxin, making them vulnerable to severe infections when trauma or open wounds occur (7).

Research by Yusufina confirms that Diphtheria Pertussis Tetanus (DPT) immunization is an effective primary prevention strategy to reduce the incidence of tetanus by building specific immunity against Clostridium tetani toxin, which is the main cause of muscle spasms and tetanus complications (6). Tetanus complications have been identified to cause neurological complications in the form of spastic paralysis due to the toxic effects of tetanospasmin on the central nervous system, such as Lacunar Cerebri Infarction, which disrupts neuromuscular

signal transmission. (8). These complications reflect systemic manifestations of severe inflammation and metabolic disturbances due to infection, and increase the risk of mortality and morbidity in pediatric patients (9).

Nervous system complications can result in limited food intake, which will impact nutritional status, including the risk of malnutrition and stunting in children (10). Chronic malnutrition and stunting significantly affect child growth and development and reduce resistance to infection. Research by Sari and Agustin showed that children with malnutrition (underweight and stunting) have a higher susceptibility to infection (11). A study by Galler reported that children with nervous system disorders can experience malnutrition (stunting and underweight) caused by eating disorders and long-term medication therapy (12).

The management of tetanus cases in children with malnutrition requires a comprehensive Medical Nutrition Therapy (MNT) approach, with a focus on providing nutritional needs and preventing metabolic disorders through a standardized nutritional care process (NCP).

## CASE DESCRIPTIVE

Pediatric patient (An. FH), a boy aged 4 years 7 months, was admitted to the Mother and Child Isolation room of Dr. Wahidin Sudirohusodo Central General Hospital, Makassar. The patient is the third of three children and lives on Semo Island with his parents and two older siblings. She lives about one hour away by boat from the nearest health center in *Pangkep* District. The history showed an infection characterized by smelly pus from the buccal and tongue that appeared four days before the seizure, and a history of a toothache for three weeks prior. Previously, the patient was treated at Tajuddin Chalid Hospital. Patient for three days (March 27-30, 2025) before being referred to Dr. Wahidin Sudirohusodo Central General Hospital, Makassar. The patient did not experience symptoms of coughing, tightness, or vomiting, but was found to have difficulty eating and drinking.

Immunization history was only recorded up to two months of age, receiving the first dose of Hepatitis B, BCG, OPV, and DPT once each. Immunizations were not continued due to family concerns during the COVID-19 pandemic, as well as perceived negative influences from the surrounding environment, suggesting barriers to education and access to immunization in the islands. Data collection (April 8, 2025) based on medical records, the patient was diagnosed with Moderate Tetanus with complications in the form of Lacunar Cerebri Infarction and a history of delayed immunization. The patient was admitted to the hospital (March 31, 2025) with complaints of seizures for four days before being admitted, accompanied by stiffness of the body, trismus, and spasm of the extremities triggered by stimuli, as well as a curved posture (opisthotonus).

Initial 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) 12 kg, body length (PB) 100 cm, upper arm circumference (MUAC) 14.5 cm with interpretation of nutritional status from the index of WHZ, HAZ, WAZ TB classified as normal. After re-measurement at the time of nutritional assessment, the results of MUAC 14.5 cm, PB 100 cm, the mother said there seemed to be a decrease in weight, but the amount was unknown, so the interpretation of nutritional status based on the percentage of MUAC 84.7% was classified as undernourished. The results of laboratory values (April 9, 2025) showed that the haemoglobin value decreased but not significantly, while in SGOT, SGPT, and sodium, there was an improvement (Table 1).

The general condition was severe pain (decreased consciousness), accompanied by mouth ulcers and white around the buccal area, there was stiffness in the body and all four extremities, the body seemed to bend, especially when touched, and the patient heard sounds. The patient's urination was via catheter (1240 ml/24 hours), blood pressure 90/60 mmHg, temperature 36.5°C, respiration 32x/min, pulse 118x/min, and $SpO_2$ 99%. The physical focus of the child's nutrition looked thin (Table 2). The patient's eating habits before the illness were staple rice 2-3 times/day (1/2-1 ladle of rice), animal side dishes every day fish and eggs (1/2 piece mixed with rice and omelet), vegetable side dishes 2-3 times/week and vegetables moringa and kale 2-3 times/week, and sweetened condensed milk 1-2 times/day (150 ml/drink). History of breastfeeding until 1 year of age. The patient's mother had not previously been exposed to nutrition information.

During the initial assessment, the patient was given Enteral Nutrition (NE) liquid diet (filtered porridge) 3 x 50 cc and commercial food (pedia-com milk) 5 x 50 cc orally. The total percentage of NE intake was energy 40.9%; protein 30.6%; and fat 54.5%; carbohydrate 40.9%; and iron, sodium, and fiber 50.5%, 19.4%, and 10.1% respectively. During the last 1 week of hospitalization, the patient stopped oral intake and was given Parenteral Nutrition (PN). The medications prescribed to the patient were Paracetamol 120 mg/8 hours IV, Ceftriaxone 1.2 g/24 hours IV, Metronidazole 360 mg/6 hours IV, Tetanus Immunoglobulin (Tetagam) 3000 IU IM once, Phenobarbital 48 mg/12 h IV, Diazepam 120 mg/kg bw/day in D5% 400 ml NaCl 0.9% (22 ml/h IV), Nystatin Drop 1 ml/8 h oral, DPT vaccine according to catch-up schedule, and 3% NaCl fluid (500 ml)/iv

## RESULTS

Establishment of nutritional diagnoses including the Nutrition Intake (NI) domain, namely NI-2.1 lack of oral food and drink related to decreased food consumption ability (nausea, vomiting so that appetite decreases) characterized by the results of 24-hour recall of energy and nutrients < 50% of total needs, NI-2.11 Limited food intake is related to neurological disorders and canker sores in the mouth area characterized by poor nutritional status, limited food/beverage intake and conditions related to medical diagnosis, and conditions related to medical diagnosis; Nutrition Clinical (NC) Domain namely NC-3.1 Underweight is related to decreased food intake (insufficient energy needs in the last 1 month) characterized by MUAC 14.5 cm (84.7%) undernutrition, insufficient food intake when compared to needs.

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 carbohydrates diet, with conditions including energy given using the Recommended Dietary Allowance (RDA) which is 1600 kcal; protein 48.0 g; fat 64.0 g preferably medium chain fat (MCT); carbohydrates 208 g; fiber 20 g; liquid 1400 ml/day; vitamin C 45 mg; iron 10 mg and sodium 900 mg/day. The form of food given is liquid via oral with 8 times of administration (06.00, 09.00, 12.00,15:00, 18:00, 21:00, 00:00, and 03:00 local time).

Nutrition education and counseling materials related to the ketogenic diet with the bedside teaching method in the PICU room ranged from 10 to 15 minutes for the patient's mother. Coordination of nutritional care collaborates with the doctor in charge (*DPJP*), the room nurse, the room nutritionist, pharmacist, and waiter. The nutritional monitoring and evaluation (M&E) plan was carried out on indicators including dietary intake using the 24-hour recall method for 7 days (target to gradually increase intake to ≥80% of needs); anthropometry was measured directly at the beginning, middle and end of the intervention (target to gradually increase MUAC size); biochemistry was observed according to laboratory tests; physical nutrition focus every day during the intervention.

The results of nutritional screening in this patient showed a high risk of malnutrition and had special conditions with moderate tetanus and severe neurological disease. The standardized nutritional care process (NCP) was carried out during 4 days of intervention at Wahidin Sudirohusodo Hospital and 3 days of home visit intervention. During the 7 days of intervention, anthropometric measurements were taken at the time of assessment, day 4, and day 7, with the result that the MUAC size became 15 cm, so that the nutritional status was included in the normal category based on MUAC. Laboratory examinations during the intervention were recorded at assessment and day 1 of the intervention (Table 1), after which no further examinations were carried out because the patient was discharged on day 4 of the intervention.

Table 1. Results of Monitoring and Evaluation of Biochemical Values

| Before Intervention | | During Intervention | | Reference Value | Interpretation |
|---|---|---|---|---|---|
| Parameter | 31/03/2025 | 09/04/2025 (examination follow-up) | 10-18/04/2025 (no inspection) | | |
| BD-1.4.2 SGOT | 127 | 52 | - | <38 U/L | Increased |
| BD-1.4.3 SGPT | 79 | 41 | - | <41 U/L | Normal |
| BD-1.2 Natrium | 132 | 136 | - | 135-145 mmol/L | Normal |

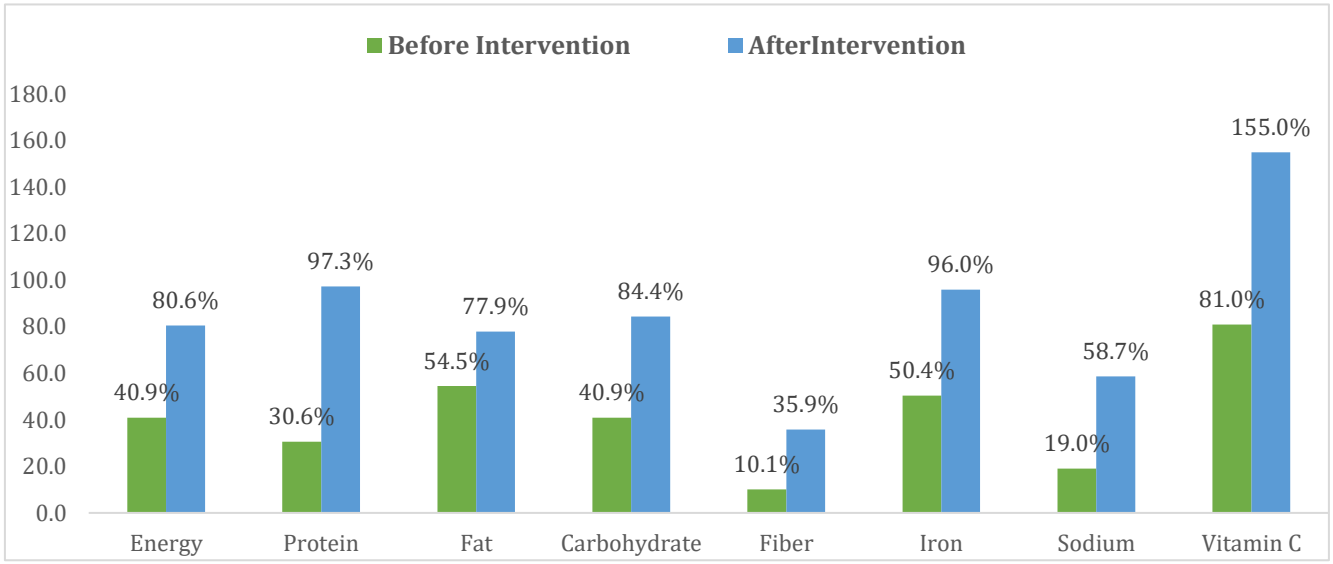
The results of the physical monitoring and evaluation of the patient's nutritional focus were observed and recorded from the electronic Recam Medic (e-RM) results during hospitalization for 4 days and observed during 3 days of home visits in Table 2:

Table 2. Results of Monitoring and Evaluation of Physical Nutrition Focus

| Before Intervention | | During Intervention | | Reference Value | Interpretation |
|---|---|---|---|---|---|
| Parameter | 08/04/2025 | 09-12/04/2025 (intervention phase in the hospital) | 13-15/04/2025 (home intervention phase) | | |
| PD-1.1.9 Vital Sign<br>Blood Pressure (mmHg)<br>Temperature (ºC)<br>SpO2 Respiration (%) | <br>90/60*<br>36.5<br>99 | <br>90/60**<br>36.5<br>99 | <br><br>- | <br>90-110<br>36.5-37.5<br>95-100 | Normal |
| PD-1 Physical Nutrition Focus | | | | | |
| PD.1.1.1 General Condition | Severely ill (sickness) | Moderately ill (minimal mobilization) | Moderately ill (minimal mobilization) | Good | Moderately |
| PD-1.1.13 Mouth | Mouth ulcer | Mouth ulcer** reduced | Good*** | Good | There's a problem |
| PD-1.1.4.5 Dyspneu | No present | No present | No present | No present | No tight |
| PD-1.1.5 Channel digestion | No present | No present | No present | No present | No present |
| PD-1.1.5.6 Anorexia | three week | Present | No present | No present | Anorexia |
| PD-1.1.5.9 Constipation | No present | No present | No present | No present | No Constipation |
| PD-1.1.2.3 Loss of biceps and arm muscle fat | None; Looks Thin | None; Looks Thin | None; Looks Thin | None; Looks Thin | None; Looks Thin |

**measured on day 1 of intervention, **measured on day 4 of intervention, ***reported on day 7 of intervention*

The results of monitoring and evaluation of patient energy intake for 7 days of intervention based on the 24-hour recall method and the results of observations made can be seen in Graph 1. Comparison of patient intake is compared with the needs gradually starting from the actual needs in the Isolation room (day 1), 60% RDA needs (day 2), 60% RDA needs (day 3, 4), 80% RDA needs, and (day 5, 6, and 7), 100% RDA needs.




Graphic 1. Monitoring Evaluation of Percentage Intake Before and After Intervention

In addition to food and nutrient intake, the interaction of drugs given such as NaCL, ceftriaxone, phenobarbital and diazepam has a mechanism that will inhibit the absorption of nutrients in the digestive tract, especially micronutrients namely calcium, sodium, folic acid and vitamin D. The results of monitoring and evaluation of education and nutritional counseling to the patient's mother showed that there was an improvement in feeding practices for children both in terms of gradually increasing portions of food, switching food consistency and adjusting the child's eating schedule. So that recommendations are given regarding the continuation of the diet gradually until it reaches 100% of the RDA requirement.

## DISCUSSION

The results of anthropometric measurements for seven days showed that the patient was still in the underweight and wasting nutritional status categories, although his height was within the normal range. Underweight indicates weight-for-age deficit, while wasting indicates weight-for-height deficit due to acute energy-protein deficiency. These two conditions often occur together in children with infectious diseases and poor intake status, and are important indicators of nutritional disorders that can affect overall health status (MOH, 2020).

Prolonged wasting has the potential to develop into stunting, a chronic linear growth disorder. According to Solana et al., wasting is an early predictor of stunting, especially in children with recurrent infections and systemic inflammatory processes (13). The results of another study conducted by Carter et al. also confirmed that children with complex diseases and prolonged nutritional deficits have a higher risk of stunting as a result of metabolic disorders and impaired nutrient absorption (14).

During the intervention period, there was a gradual increase in energy and nutrient intakes, which were previously very low. Initial intakes were very low (<50%) of target requirements, but after progressive intervention according to patient acceptability, there was a significant increase in energy, protein, and carbohydrates. This approach is in line with the principle recommended by ESPEN and ASPEN that individualized nutrition therapy can be phased in according to the patient's physical/clinical condition and acceptability (15).

The increased energy intake during the intervention reached 80% of the target requirement. This has the effect of metabolic adaptation to the ketogenic diet, which can help transition from the hypometabolic phase to the recovery phase. In the context of a ketogenic diet, the main source of energy comes from fat that produces ketones, which are efficient, anti-inflammatory, and support cell and mitochondrial function, especially in systemic inflammatory conditions (15).

Protein intake increased gradually to reach 97.3% of the target daily requirement by the end of the intervention, which was sufficient to support anabolism without interfering with the ketosis process. Controlling intake is necessary as excess protein can trigger gluconeogenesis and inhibit ketonemia (16).

Fat intake is the main source of energy on the ketogenic diet. Fat intake is increasing, although it has not reached the optimal target due to the high demand for the ketogenic diet. MCT fats provide the advantage of fast and efficient ketone production and play a role in protecting nerves and reducing inflammation. Ketones also support nerve recovery through

membrane stabilization and decreased excitotoxicity (17). Carbohydrate intake is increased until it reaches the target daily requirement. Carbohydrate intake on a ketogenic diet that exceeds daily requirements will be a major inhibitor of ketosis, as it increases insulin and decreases lipolysis. In ketogenic therapy, strict control of the amount and type of carbohydrate is essential to maintain the therapeutic effect, especially in conditions of Neurological disorders (18).

The implementation of a ketogenic diet requires specific and continuous counseling. The focus of counseling includes the selection of healthy fats, low- purine quality proteins, and control of carbohydrates to maintain the condition of ketonemia. Dietary ratios are adjusted according to patient tolerance, and monitoring is done to prevent muscle catabolism and metabolic imbalance. This approach has been shown to support brain function and neuro recovery in neurologically active conditions (19).

Continuous nutrition education for families to provide an understanding of nutritional interventions according to the needs of children, both during treatment and after being at home. Educational materials include the selection of local food ingredients according to availability in the surrounding environment, food processing techniques, and meal schedules and portions (20).

The results of nutritional screening, follow-up laboratory tests, physical data on nutritional focus, micronutrient intake, and drug interactions with nutrients during the intervention were reported in this study but not further elaborated in the discussion.

## CONCLUSION

Based on the case description, an individualized approach to nutritional care management was shown to increase the patient's food intake, thereby increasing muscle mass during the intervention and improving maternal feeding practices.

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