Formulating Diet for Transitional Feeding in Tuberculous Meningitis Patient during Hospital Care and through to Period of Home Healthcare

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Summary Tuberculosis (TB) affects one-third of the world’s population and is the leading cause of human mortality and morbidity. Tuberculous meningitis (TBM) is the most severe type of extrapulmonary disease. Medical treatment and nutritional management is the most efficient and cost-effective of all health interventions. In case: A 25-y-woman presented with loss of appetite, fluctuating fever for two weeks, and loss of consciousness for 9 d. There was no history of headache, nausea, vomiting and neck pain. Physical examination shows signs of meningeal irritation, anemia, dermatitis in neck, armpit and back, decubitus and limb paralysis. Laboratory examinations showed normocytic normochromic anemia, immune depletion, hypoalbuminemia, hyponatremia, hyperlipidemia and elevated liver transaminase. Nutritional therapy was given by enteral nutrition, contained of high protein and choline ONS (oral nutritional supplement), blenderized diet. Vitamin A, B complex, C, D, zinc, and cork fish extract as the source of albumin, immunonutrient such as fish oil was given as supplementation. After 35-d of treatment, there were increased of albumin plasma and lymphocyte level, accelerated wound healing, dermatitis, and functional capacity. Home healthcare visit and physiotherapy was conducted for about 1-month to support oral feeding from liquid to blenderized diet to porridge and improve cognitive and functional capacity. This report is intended to describe how nutritional support with transitional feeding to enhance adequate intake can accelerate wound healing, decrease morbidity and mortality rate in TBM patient.

Key Words tuberculous meningitis, transitional feeding, nutritional support

Tuberculosis (TB) affects one-third of the world’s population and is the leading cause of human mortality and morbidity. Treating tuberculosis is the most efficient and cost-effective of all health interventions. TB results in two million deaths annually and 98% of these deaths occur in the developing countries, mostly Africa and Asia. TB incidence in Indonesia is rank 5th after India, Cina, Nigeria, Pakistan, with prevalence 0.4% from all population in 2013. TB of central nervous system (CNS) constitutes 5% of extra pulmonary cases. In 2015, an estimated 10.4 million new cases of TB occurred worldwide (1–3).

Tuberculous meningitis (TBM) is the most frequent form of CNS tuberculosis and the most severe form of infection caused by Mycobacterium tuberculosis, causing death or disability in more than half of those affected. The development of the disease is insidious, following phases can be differentiated: 1) Prodromal symptoms such as malaise, mild fever, loss of appetite, headache, which are not typical, and their duration may extend to several weeks; 2) Neurological symptoms which include lethargy, progressive cognitive disorders, cranial nerve palsy (usually oculomotor) and meningeal signs; 3) Paralysis with concomitant coma, increase in intracranial pressure, and subsequent increase in intracranial fluid space. Late and atypical presentation of TBM is common in developing countries which may lead to delay in diagnosis and to increased mortality and morbidity in as timing of treatment and nutritional management is crucial for the prognosis (4, 5).

Nutritional management and transitional feeding are known to play an important role in immobilized patient to prevent malnutrition. Nutritional support using enteral (EN) and parenteral nutrition (PN) is critical to prevent malnutrition in hospitalized patients with inadequate dietary intake. Adequate intake of macronutrients and micronutrients before, during and after rehabilitation can affect morbidity and mortality, maintain lean body mass, prevent metabolic complications and improve immune system, cognitive and functional capacity (6–8).

We report the case of TBM patient who was admitted in HCU (High Care Unit) for 35 d and was under nutritional management focused on EN assisted with PN and then successfully switched to oral feeding in health home care. We observed that NST (nutritional support team) care stabilized of the symptoms of the patient and led to discharge without complications.

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MATERIALS AND METHODS

A 25-y-old female patient was admitted to Wahidin Sudirohusodo hospital with complaint of fluctuating fever and loss of appetite for 2 wk. Patient recently became irritable and unconscious since 9 d ago. She had no history of headache, nausea, vomiting and neck pain. She had no seizure or blurring of vision.

There was no history suggestive of respiratory, cardiac, or urinary abnormalities. There was family history of TB. On examination patient was pale with Glasgow coma scale of 9/15. Patient had signs of meningeal irritation and limb palsy. She had dermatitis in neck, armpit and back, decubitus ulcer. Clinical characteristics of the patient on admission are shown in Table 1.

RESULTS

The blood tests revealed decline of hemoglobin (9.9 g/dL), normal white blood cell count (5,700/cummm) but decreased TLC/total lymphocyte count (565 cell/μL), elevated liver transaminase (AST 101/ALT 231 U/L) and elevated lipid profile (total cholesterol 326/LDL 263 mg/dL).

Albumin (3.1 g/dL) and Na⁺ (132 meq/L) were slightly reduced. Chest X-ray showed bilateral diffuse military infiltrates (Fig. 1). CSF analysis revealed normal glucose of 60 mg/dL (reference range 50 to 80 mg/100 mL), CSF to blood glucose ratio was low (<0.5), protein was elevated (128 mg/dL). No acid fast bacilli/Gram-reactive organism found, cell count was more than 5 cells/mm³ (32/3), predominantly lymphocytes.

Her first cranial CT Scan findings were hypodense lesion left ganglia basalis sugestif early cerebritis or TBM or infract cerebri (Fig. 2a). 1 mo after treatment cranial CT Scan was repeated (Fig. 2b). A provisional diagnosis of TBM was made and patient was started on enteral anti-tubercular treatment. Patient was consult for nutritional management and dermatology problem. On referral to NST, the patient’s nutritional status was moderate malnutrition based on Subjective Global Assesment (SGA).

The patient was initially supported by gastroenteric feeding 7 d in other hospital and we continued to using it. Feeding tube was checked for gastric residual volume (GRV). Enteral nutrition was stopped if GRV 250–500 mL per 4 h. The required dose of 1,750 kcal and 77–92 g protein (1.5–2 g protein/kg IBW), calculated on the basis of body weight MUAC, Harris Benedict equation with 1.3 stress factor.

The progression of nutritional support and clinical aspects of the patient during admission was shown in Table 2. Enteral nutrition was given as nutritional therapy, contained of high protein and choline ONS (oral nutritional supplement), blenderized diet (Table 3). Supplementation is vitamin A, B complex, C, D, zinc, which is necessary for immune function and wound healing and cork fish extract as the source of albumin, immunonutrient such as fish oil for anti-inflammatory effect.

On day 13, we increased energy requirement with 1.4 stress factor because spastic of upper left extremity. Estimated energy was 1,950 kcal and on day 22 protein requirement was 102 g based on balance nitrogen (BN). Again, protein composition of standard enteral formula was not enough to meet the demand, so NST advised to use high protein enteral formula. The energy and protein deliveries during hospital stay were shown in Figs. 3 and 4. The patient showed improvements and transferred to general wards. On day 31, we calculated energy requirement to management of increased body

| Table 1. Clinical characteristics of the patient on admission. |
|---------------------------------------------------------------|
| **General characteristics** | **Value** |
| Age, y | 25 |
| Sex | Female |
| Anthropometric indexes | |
| Height, cm | 157 |
| Mid-upper arm circumference (MUAC), cm | 21 |
| Ideal body weight (IBW), kg | 51.3 |
| Body weight MUAC, kg | 42 |
| Vital signs | |
| Body temperature, °C | 37 |
| Pulse rate, bpm | 100 |
| Systolic/diastolic blood pressure, mmHg | 120/90 |

Fig. 1. Chest X-ray.

Fig. 2. Cranial CT scan.
Table 2. Progression of nutritional support and clinical aspects of the patient.

| HOD | Clinical aspects | Decision therapy of NST consult | Enteral feeding | Oral diet |
|-----|------------------|---------------------------------|----------------|----------|
| June –14 | Fever, reduced intake |  |  |  |
| –9 | Unconscious | Feeding tube (other hospital) |  |  |
| July 1 | Admission Wahidin Sudirohusodo hospital |  |  |  |
| 3 | 1st Continued enteral feeding | Blenderized diet, ONS |  |  |
| 13 | Spastic of upper left extremity | 2nd Increased stress factor and energy requirement | Blenderized diet, ONS |  |
| 22 | 3rd Increased high protein formula | Blenderized diet, ONS with choline |  |  |
| August 31 | 4th Calculate again energy requirement | Blenderized diet, ONS |  |  |
| 45 | Start oral diet | Stop tube feeding | Blenderized + soft diet, ONS with choline |  |
| 50 |  |  | Soft diet, ONS with choline |  |
| 60 |  |  | Regular diet, ONS with choline |  |

HOD = hospital onset of day; NST consult = nutrition support team consult.

Table 3-1. Composition blenderized diet, ONS, ONS with choline, soft diet and regular diet.

| Blenderized diet | Weight (g) | Energy (kcal) | Water (mL) |
|-----------------|------------|---------------|------------|
| Carbohydrate    | 26.3       | 108.9         | 100        |
| Protein         | 17.2       | 68.8          | 75         |
| Fat             | 10.2       | 91.8          | 75         |
| Total           | 53.7       | 269.5         | 250        |
| ONS             |            |               |            |
| Carbohydrate    | 42         | 167           | 150        |
| Protein         | 14         | 56            | 50         |
| Fat             | 13         | 27            | 50         |
| Total           | 59         | 250           | 250        |

Table 3-2. Composition blenderized diet, ONS, ONS with choline, soft diet and regular diet (cont').

| ONS with choline | Weight (g) | Energy (kcal) | Water (mL) |
|-----------------|------------|---------------|------------|
| Carbohydrate    | 44         | 185           | 150        |
| Protein         | 15         | 60            | 50         |
| Fat             | 5          | 45            | 50         |
| Total           | 64         | 290           | 250        |
| Soft diet       |            |               |            |
| Carbohydrate    | 52         | 212           | 225        |
| Protein         | 17         | 68            | 75         |
| Fat             | 5          | 45            | 50         |
| Total           | 74         | 325           | 350        |
| Regular diet    |            |               |            |
| Carbohydrate    | 52         | 212           | 200        |
| Protein         | 17         | 68            | 50         |
| Fat             | 5          | 45            | 50         |
| Total           | 74         | 325           | 300        |

Estimated energy was 2,100 kcal.

The patients couldn’t successfully switched to oral diet but was discharged without significant complication. At discharge, mid-arm circumference was 21 cm. Results of biochemical test of the patient during hospitalization are shown in Table 4. One month after discharge, through checkup was performed at outpatient clinic and found improvement in functional and cognitive function so the patient was successfully switched to...
oral diet. All biochemical test results were negative for anomaly (Table 5).

Changes in clinical indices of nutritional status were shown in Fig. 5. Concentrations of albumin, TLC and UUN are useful markers of nutritional status and immune function. Albumin level is a sensitive marker of visceral protein but may not represent whole body protein. However, it is still useful in screening malnutrition. Moreover, TLC serves as markers of immune function and UUN as markers of catabolism and to calculate balance nitrogen for protein requirement. As shown in Fig. 5, albumin and TLC levels were below normal range at

![Fig. 3. The amount of energy delivery during hospital stays.](image1)

![Fig. 4. The amount of protein delivery during hospital stays.](image2)

| Table 4. Results of biochemical test of the patient during hospitalization. |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Laboratory          | 7/7                  | 9/7                  | 11/7                 | 17/7                 | 21/7                 | 26/7                 | 3/8                  | 8/8                  | 11/8                 | 13/8                 |
| Hb                  | 9.8                  | 9.9                  | 9.9                  | 10.2                 | 11.8                 | 12.8                 | 12.0–16.0 gr/dL.      |
| MCV                 | 81                   | 82                   | 80                   | 84                   | 86                   | 87                   | 80.0–97.0 Fl          |
| MCH                 | 26                   | 25                   | 27                   | 27                   | 28                   | 28                   | 26.5–33.5 pg          |
| MCHC                | 32                   | 31                   | 33                   | 32                   | 33                   | 32                   | 31.5–15.0 g/dL        |
| WBC                 | 5.7                  | 5.2                  | 6.9                  | 5.8                  | 6.6                  | 8.3                  | 4.0–10.0 Fl /UL       |
| TLC                 | 565                  | 494                  | 518                  | 824                  | 940                  | 1,190                | 2.0–4.0 Fl /UL        |
| PLT                 | 188                  | 235                  | 157                  | 336                  | 307                  | 261                  | 150–400 x10^3/mm^3   |
| Blood glucose       | 141                  | 140                  | 121                  |                      |                      |                      | 140 mg/dL             |
| AST                 | 101                  | 39                   | 188                  | 125                  | 65                   | 54                   | 62                   | 59                   | < 38 U/L             |
| ALT                 | 231                  | 117                  | 174                  | 246                  | 132                  | 64                   | 94                   | 61                   | < 41 U/L             |
| Albumin             | 3.1                  | 3.1                  | 3.6                  | 3.9                  | 3.6                  | 3.6                  | 3.5–5.0 g/dL          |
| Total Protein       | 5.7                  | 5.9                  | 6.7                  | 6.4                  | 6.2                  | 6.2                  | 6.6–8.7 g/dL          |
| Globulin            | 2.6                  | 2.8                  | 3.1                  | 2.6                  |                      |                      |                     |
| Urea                | 20                   | 29                   | 22                   | 28                   | 22                   | 28                   | 10–50 mg/dL           |
| Creatinin           | 0.32                 | 0.34                 | 0.3                  | 0.3                  | 0.3                  | 0.3                  | 0.33                 | <1.1 mg/dL           |
| Natrium             | 132                  | 137                  | 132                  | 136                  | 135                  | 140                  | 137                  | 136–145 mmol/L        |
| Kalium              | 4.1                  | 4.4                  | 3.2                  | 3.8                  | 3.9                  | 3.7                  | 3.8                  | 3.5–5.1 mmol/L        |
| Chloride            | 95                   | 96                   | 89                   | 97                   | 89                   | 93                   | 91                   | 97–111 mmol/L         |
| PT                  | 10.5                 |                      |                      |                      |                      |                      |                      | 10.14 detik           |
| INR                 | 0.98                 |                      |                      |                      |                      |                      |                      |                     |
| APTT                | 21.6                 |                      |                      |                      |                      |                      |                      | 22–30 detik           |
| Uric acid           | 2.0                  |                      |                      |                      |                      | 9.2                  | 6.8                  | P<1.4–5.7;           |
| Total cholesterol   | 326                  |                      |                      |                      |                      | 174                  | 200 mg/dL             |
| HDL                 | 55                   |                      |                      |                      |                      | 55                   | L > 55;              |
| LDL                 | 263                  |                      |                      |                      |                      | 125                  | <1.30 mg/dL           |
| Triglyceride        | 191                  |                      |                      |                      |                      | 105                  | 200 mg/dL             |
| Total bilirubin     | 0.41                 |                      |                      |                      |                      | 0.2                  | 0.2–1.2 mg/dL         |
| Direct bilirubin    | 0.23                 |                      |                      |                      |                      | 0.0–0.2 mg/dL         |
| Phosphate alkali    | 90                   |                      |                      |                      |                      | 204                  | L<270; p<240 U/L      |
| βGT                 | 130                  |                      |                      |                      |                      | 112                  | L(11–50); P(7–32) U/L |
| Salmonella Typhi    | O+1/80 H-            |                      |                      |                      |                      |                      |                      |                     |
| Paratyphi           |                      |                      |                      |                      |                      |                      |                      |                     |
| Prokalsitonin       |                      |                      |                      |                      |                      |                      | 0.05                 | <0.05 ng/mL           |
| UUN                 | 9.8                  | 13                   | 10                   | 6                    |                      |                      | 17 g/24 jam           |
| Nitrogen balance    | −8.3                 | +6.4                 | +1.9                 | +4.6                 |                      |                      |                      |                     |


the time of admission but have improved significantly during hospitalization. In early stage of hospital stay, UUN was high and slowly regressed 1-month during hospitalization. Balance nitrogen from negative to positive is modified with higher protein provision, may be related to a better prognosis.

**DISCUSSION**

Subject of this case report was hospitalized for 35 d. During that period, the patient was under intensive care in HCU for 20 d, general wards 15 d. While in HCU, the subject was on enteral and PN due to difficulty in oral intake.

In general ward the subject was still on enteral. Home healthcare visit for about 1-mo and physiotherapy to support transitional to oral feeding from liquid to blenderized diet until porridge and improve cognitive and functional capacity. For majority of the medical patients in HCU, nutritional management is recommended due to complications of disease may lead to hyper-metabolism and subsequent malnutrition. These conditions necessitate proper enteral and PN for patients.

The American Society for Parenteral and Enteral Nutrition (ASPEN) guideline advises to deliver early nutritional support therapy, primarily by the enteral route, and start PN as early as possible when EN is not feasible in poorly nourished patients. The European Society of Clinical Nutrition and Metabolism (ESPEN) also states that all patients who are not expected to be on normal nutrition within 3 d should receive PN within 24–48 h if they cannot tolerate EN. As for the patient in this case report, PN was commenced on day 4 of hospitalization and lasted about 8 d. PN was given to fulfillled protein and fat composition. Meticulous attention should be paid to mineral and electrolyte balance of the PN. TBM patient are prone to mineral deficiency due to fever, sweat or urine loss and other complication. Deficiencies of zinc, iron, selenium and vitamin A, B, C are quite common and these deficiencies can increase the risk of multiple organ failure, muscle wasting, delayed wound healing and impaired immune function (8–10).

Meanwhile the patient suffered weight loss during hospital stay but accurate estimation of body weight could not be achieved because the patient was immobilized. In this patient, sufficient enteral nutrition was given and when the clinical symptoms started to improve, the patient has been given of added calorie target to increased body weight. The mid-upper arm cir-

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| Laboratory          | Outpatient Clinic | Normal Value   |
|---------------------|-------------------|----------------|
| Hb                  | 12.8              | 12.0–16.0 gr/dL|
| MCV                 | 87                | 80.0–97.0 Fl   |
| MCH                 | 28                | 26.5–33.5 pg   |
| MCHC                | 32                | 31.5–35.0 g/dL |
| WBC                 | 7.4               | 4.0–10.0×10³/μL|
| TLC                 | 1.890             | 2.0–4.0×10³/μL |
| PLT                 | 242               | 150–400×10³/mm³|
| Total bilirubin     | 0.52              | 0.2–1.2 mg/dL  |
| Direct bilirubin    | 0.19              | 0.0–0.2 mg/dL  |
| ALT                 | 37                | < 38 U/L       |
| AST                 | 68                | < 41 U/L       |
| Albumin             | 4.0               | 3.5–5.0 g/dL   |
| Ureum               | 20                | 10–50 mg/dL    |
| Creatinin           | 0.20              | <1.1 mg/dL     |

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![Fig. 5. Changes in the UUN, albumin, and TLC of the patient.](image-url)
cumference (MUAC) decreased 0.5 cm from 21 cm in 14 d treatment, but with adding calorie and protein target the MUAC increase at 21 cm again. This indicates the necessity of intense nutrition intervention including enteral or oral nutrition supplement during transitional feeding period. The increased protein provisions could have influenced both the synthesis of skeletal muscle protein and the availability of amino acids as substrates in the synthesis of metabolic and immunological mediators and structural components. Follow up and reevaluation of tube-fed patients is critical to identify positive changes in swallowing ability that may permit transition from tube to oral feeding.

In conclusion, in difficult situations where the patient was suffering from increased nutrition demand after critical phase, monitoring and intervention of NST can improve the symptoms and assist swift recovery of the patient. In line with proper treatment of medical time, continuous nutrition care of NST led to the significant improvements in clinical indices of disease and nutritional status. For the management of immobilized patients, accurate requirement estimation of macronutrients and micronutrients is important. Additional dose of nutrients and timing of nutrition is critical. Therefore, monitoring of patient followed by elaborate nutrition care of NST and physiotherapy is essential for the excellent clinical outcome for transitional feeding patient.

Disclosure of state of COI

No conflicts of interest to be declared.

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