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ORIGINAL PAPER

The role of medical nutrition therapy on nutritional status, functional capacity and quality of life of pulmonary tuberculosis patients with difficulty

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Abstract

Pulmonary tuberculosis (pulmonary TB) is a chronic infectious disease with high levels of morbidity and mortality. Metabolic changes due to tuberculosis *Mycobacterium* infection and activation of the neurohormonal system contribute to the occurrence of malnutrition, which can have a negative effect on the prognosis of patients with pulmonary TB, as well as decreased functional capacity and quality of life. The provision of medical nutrition therapy from the beginning of diagnosis is upheld, supporting the recovery process of TB patients. In this series of cases, there were four cases of pulmonary TB patients with difficulty, namely TB billion, chronic obstructive pulmonary disease (COPD), and meningitis TB. At the beginning of the examination, there was a deficiency of macronutrients and micronutrients, hypoalbuminemia, anemia, and decreased functional capacity and quality of life. Medical nutrition therapy is administered individually, according to clinical conditions such as TB with mild, moderate and severe malnutrition, those are gradually weight loss and muscle wasting when the symptoms start until treated in intensive care unit (ICU) and hospital ward. According to laboratory parameters such as anemia, hypoalbuminemia, and a history of food intake analysis such as hypocaloric and starvation.

Keywords: pulmonary TB, malnutrition, medical nutrition therapy, quality of life

Introduction

Based on World Health Organization (WHO) data in 2016, there are an estimated 10.4 million tb cases worldwide, with 1.3 million deaths.[1] According to data from the Ministry of Health of the Republic of Indonesia, Indonesia is the country with the second most TB patients in the world after India. In Indonesia there are an estimated 429,730 new cases of TB, with 62,246 deaths. Incidence of acid-resistant bacterial TB (BTA) cases was positive at 102 per 100,000 inhabitants.[2] Research shows a link between TB and malnutrition. Hsin-Haos Lai et al.[3] research showed that 67% of TB patients have body mass index (BMI) less than 18.5 kg/m^2 and happen in men. Semba et al.[4] showed that malnutrition can increase the risk of developing TB infection by 3.2

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times.[4] Patients with active pulmonary TB accompanied by malnutrition need appropriate nutritional interventions.[5] In table 1 we can see the summarized of some cases.

Table 1. Serial case summary

Variable	Case 1	Case 2	Case 3	Case 4
Male	Male	Male	Male	Male
Age	37 years old	49 years old	74 years old	22 years old
Education	Elementary school	Elementary school	High junior school	High junior school
Risk factors	smoker, alcohol, pollutan, poor ventilation	smoker, alcohol, Type 2 DM, pollutan	smoker,alcohol, MG	smoker, pollutan, poor ventilation
Clinical diagnosis	TB billion, lymphadenitis, multipel TB	ARDS, meningitis TB, pulmonary TB, Type 2 DM	ARDS, COPD et causa pneumonia, pulmonary TB	Pleura TB
BMI (kg/m^2)	13,6	16,8	22,2	17
Weight loss	20 kg in 4 months (33%)	15 kg in 4 months (27%)	unknown	6 kg in 1 month (12%)
Nutritional status	Severe malnutrition	Moderate malnutrition	Clinically appropriate malnutrition (ASPEN criteria)	Moderate malnutrition
Duration of treatment	6 days	6 days	9 days	6 days
Complaints	Tightness, chronic cough, neck lumps, fatique, night sweats	Decreased consciousness,chronic cough, headache, stiff neck, vomiting, fever	Tightness, fever, vomiting, chronic cough	Tightness, cough
Examination of physic	ronchi, wheezing, xylophone ribs, muscle wasting	ronchi, wheezing, xylophone ribs, muscle wasting, edema dorsum pedis	ronchi, wheezing, muscle wasting	ronchi, wheezing, muscle wasting
Laboratory	Anemia, hypoalbuminemia, hypocalcemia, increased CRP, Gen x-pert positive	Anemia, hypoalbuminemia, increased CRP, positive BTA	Leukosytosis, hypocalsemia, metabolrespiratory acidosis, increased CRP, positive BTA	Leukosytosis, increased CRP, negative BTA
Photosnof plain chest	TB billion, right pleural effusion	TB duplex pulmonary	Ex-TB pulmonary duplex	TB pulmonary, right pleural effusion
Nutritional achievement during treatment	135% TEE	REE	TEE	80% TEE
Micronutrients	B1, B6, folic acid, C, A, D, E, zinc	B1, B6, folic acid, C, A, D, E, zinc	B1, B6, folic acid, C, A, D, E, zinc	B1, B6, folic acid, C, A, D, E, zinc

Table 1. Serial case summary

Variable	Case 1	Case 2	Case 3	Case 4
Specific nutrients	Omega-3	Omega-3	Omega-3	Omega-3
Functional capacity (KPS score)	30 → 80	10 → 10	20 → 60	30 → 90
Specific nutrients	MUFA	MUFA	MUFA	MUFA
Quality of life (SF-36 score)	15 → 85	5 → 5	30 → 70	20 → 90
Clinical Outsider	Return home	died	Return home	Return home

Description : ARDS (acute respiratory distress syndrome*)*; ASPEN (The American Society for Parenteral and Enteral Nutrition); BTA (acid-resistant basil); CRP *(C-reactive protein);* DM (diabetes mellitus); BMI (Body mass index); REE (Resting Energy Expenditure); TEE (Total Energy Expenditure); MG (myasthenia gravis*);* COPD (chronic obstructive pulmonary disease); TB (tuberculosis).

Diagnosis

Diagnosis in all four patients was found based on anamnesis, weight change, history of intake analysis, physical examination, supporting examination such as BTA sputum, laboratory, and radiology. The findings of the examination in all four patients had been malnourished before the clinical symptomps appears. This makes their condition difficult when they has chronic *Mycobacterium tuberculosis* infections. In their cases we found long duration of coughs more than 2 weeks, decreased weight, fatigue, decreased appetite, smoking and drinking habits as well as low levels of education. Two patients had DM comorbidity and myasthenia gravis (MG) which made the conditions of patients with TB infections relatively more difficult to control.

The four patients came from low socioeconomic, dense environment, and poor residential ventilation, as well as contact with family/workmates and neighbours who had a history of chronic cough and TB, and had difficulty in obtaining a healthy diet with balanced nutrition according to the patient's energy needs due to low socioeconomic and lack of knowledge about balanced nutrition and management. These four cases experienced limited food intake and excessive workload leading to fall into a state of malnutrition. Based on nutrisurvey analysis data before illness, the first, second , and fourth patients showed the total energy intake, amount of protein and percentage of fat and protein are low compared to basal energy needs and the total needs of patients.

The four cases of malnutrition according to ASPEN criteria are: decreasing in energy intake before illness in at least one month, weight loss more than 7.5% in one month or >10% within six months, decreasing in subcutaneous fat mass and decreased muscle mass in the temples, clavicle, acromion, a mild pitting edema, and reduction in functional status.[6]

The second and third case patients entered the ICU because they were identified as having experienced type 1 respiratory failure. For the second patient due to chronic cardiorespiratory disorders (in the form of shortness of breath due to TB) which is aggravated by uncontrolled hyperglycemia in DM to sepsis that manifests also into the nervous system of the brain becomes meningitis TB. The third case patient suffered type 1 respiratory failure, caused by CO_2 intoxication resulting failure of the cardiorespiratory system as a consequence of impairment compliance, ventilation and pulmonary diffusion as a process of recurrent MG disease and lesions of the respiratory muscles.[7]

Governance

Based on WHO recommendations, nutrition management in TB is an assessment of the nutritional status of patients, nutrition education,

malnutrition management, and micronutrients supplementation.[9,10] Recommendations for nutrition in patients with pulmonary TB ranging from 25–30 kcal / kg BW / day. Calorie calculation is recommended using dry weight. Nutrition provision might gradually increase of 10–20% up to the total energy needs for 7 days. Basal energy need is calculated using the Harris-Benedict formula, the calculation results are then multiplied by stress factors to obtain total energy needs. Stress factors used by 1.3–1.5 are adjusted to the state of hypermetabolism experienced by the patient especially there is a difference when the patient is in critical condition in intensive care and hospitalized. WHO recommends providing nutrition with a balanced composition, namely protein 15-20%, fat 25-35% and carbohydrates 45-60%.[6]

Solutions to improve pulmonary power in patients in the second and third cases are obtained from the mechanical ventilation process by adjusting the ventilator mode used and gradually lowered from the PC ventilator mode to PSIMV until the ventilator machine is removed, and takipneu that has been overcome. Nutrition is given gradually starting from 80% hich is 900 kcal energy (18 kcal/Kg BW/day) with protein of 0.8 grams/kg BW/day. The provision of nutrition to these patients in accordance with the recommendations of ESPEN 2018 and ASPEN 2016.[8,9] Other considerations were given 900 kcal because the food intake of four months before illness was 588 kcal in the form of regular meals to porridge, so the nutritional as increased by 20% in the form of liquid diet via tube feeding.

Protein intake in the second case begins with 0.8 g/kg/day, with nitrogen to non calorie protein ratio = 1/100 derived from animal protein diebetes liquid formula 3x100 ml, 3x150 ml increases gradually to 200 ml, 1-3 egg whites, as well as grains are given in fruit juice mixture. The administration of final proteins in stable patients such as the first, third and fourth cases according to the guidelines reaches 20% of total energy expenditure (TEE). Fat is given as much as 30% of TEE, in accordance with WHO recommendations, fat administration of 25-35% with the composition of fat types as recommended, namely saturated fatty acids (SAFA) <7%, polyunsaturated fatty acids (PUFA) ≤10%, and monounsaturated fatty acids (MUFA) ≤15%. Carbohydrates are recommended at 45–60% TEE. From the data of the four patients obtained from the analysis of intake when sick, it appears that the composition is less MUFA and omega-3 of PUFA, so that in the second case patients added omega-3 specific nutrients and additional MUFA content that is useful to support TB recovery and reactive hyperglycemia control that occurs in sepsis with DM.[10] Selected liquid foods in the form of commercial diabetes formula / diabetes liquid to control reactive hyperglycemia that occurs. Preferred commercial diabetes formula with consideration of fiber content is higher than diabetes liquid, which is 4 dietary fiber per 260 mL commercial diabetes formula compared to 1.7 grams per 260 ml diabetes liquid.

The results of analysis of the intake of four patients before illness and during treatment showed a lack of micronutrients intake compared to daily intake needs, so that micronutrients can be given as supplementation in the form of vitamin B1, B6, folic acid, C, A, D, E, zinc.[11,12] Post-treatment, based on the results of nutrisurvey analysis of the four patients before illness was seen macronutrients and micronutrients and specific nutrients insufficient daily intake needs, then given micronutrients supplementation namely Renovit® and omega-3 capsules and support from commercial omega-3 liquid diet to support the recovery phase of TB patients. Liquid diet selection is because it contains EPA of 1 gram per bottle (200 mL).

Result, monitoring and outcome

Three out of four patients experienced increasing calories of daily intake, improved clinical condition, functional capacity (based on KPS score), as well as quality of life (based on patient SF-36 score). The nutritional status of the patient does not worsen during treatment. All three patients had a good level of adherence to TB therapy and given medical nutrition therapy. One case died during treatment.

During six days of monitoring, three patients showed good results, it can be seen that there is an increase in appetite that meets the needs of daily

brain glucose levels, so that it can accelerate the non-dependence on ventilator use in the isolation ICU. So that patients can be discharged on days 6 and 9 with a target of nutrition achieved at least 80% total energy needs (TEE) and showed improvements in quality of life and functional capacity from heavy to light dependency. In some patients also experienced improvements from laboratory results on albumin, CRP, and hemoglobin. Unless there is one patient with TB meningitis accompanied by a history of uncontrolled DM with a history of alcohol drinkers, it worsens on the sixth day of treatment after two days off the ventilator machine, from the isolation ICU room moved to the isolation ward.

Discussion

Malnutrition can lead in lowering body's immunity, increasing susceptibility to infection, and increasing the severity of infection. On the contrary, TB is the cause of malnutrition, caused by low food intake, absorption disorders of nutrients in the intestine, increased basal metabolic requirements, increased protein catabolism processes, and increased need for specific nutrients due to infection.[13]

Increased energy needs can be caused by a state of hypercatabolism, which play a role in the occurrence of malnutrition in these pulmonary TB patients. Malnutrition in pulmonary TB can also be associated with low appetite that can affect the inadequate macronutrients and micronutrients intake. This conditions also accompanied by hypercatabolic conditions, resulting in worsened malnutrition which accompanied with anemia, hypoalbuminemia, muscle wasting, and other clinical symptom.[13]

Animal to plants protein ratio by 2:1 with consideration in that animals has a higher biological value than plant proteins. Moreover, in the most of TB patients have chronic anemia that requires absorption of amino acids in the gastrointestinal tract more optimally. Combined animal and plant proteins for optimal nutritional balance. This balance is also important in controlling excessive amounts of iron. Iron is still needed in nutritional medical therapy, but excessive amounts or ferroptosis might increase the number of necrotic cells due to macrophags infected with *Mycobacterium tuberculosis* that undergo lipid peroxidation and are affected by the work of GSH and Gpx4 levels.[14]

The selection of higher levels of dietary fiber in order to reduce the glycemic index is expected to maintain blood glucose level and increase insulin sensitivity.[15] In the diet prescription from the second case patients added with 5–10 grams (1–2 teaspoons) of olive oil as a source of MUFA that plays a role in controlling the blood glucose levels.[10] During clinical monitoring it is also showed a decrease in oxygen fraction in ventilator use. This indicates that the appropriate provision of nutrients does not burden the patient's condition, but accelerates the patient's recovery for weaning.[16] In the case of ventilator use in the second and third patients are given energy gradually to meet their basal needs, so that the acceleration of weaning from the ventilator can be achieved.

The function of vitamin B complex, B12, and folic acid is to inhibit the formation of homocysteine. Homocysteine can exacerbate endothelial damage, increase low density lipoprotein (LDL) oxidation, increase monocyte adhesion to the endothelial wall, increase the risk of thrombosis due to clotting disorders or platelet dysfunction, and decrease the nitric oxide response. Patients also administered an antioxidant vitamin C that play role to inhibit the oxidation of LDL, and decreases the production of nitric oxide to dilate blood vessels.[17] One of vitamin D function which associated with immunity support is it has antimicrobial response in the form of autophagy, fagolisomal, cathelicidin activation that eradicates *Mycobacterium tuberculosis*.[11,12]

Micronutrients play an important role in individuals with TB.[12] Systematic review conducted by Sinclair et al.[5] showed that individuals with active pulmonary TB who received vitamin A, D, zinc, selenium, B, and C supplementation during TB therapy had more BW enhancements than those who did not receive supplementation.[12] Junaid et al.[11] explained that further research is needed on vitamin D supplementation with the right dose to support the recovery of lung TB patients.[11] Vitamin and mineral supplementation recommended in TB is 50-150% of the number nutritional adequacy.[12] In TB there is an

increased need for micronutrients that cannot be obtained only from feeding.[6,12] Nutritional therapy in TB can accelerate the healing process of the disease by improving the immune system, increasing weight, strengthening muscles including respiratory muscles and pulmonary parenchymal tissue and improving the quality of life of patients and reducing the length of hospitalization, which can be assessed by improving the functional capacity and quality of life of patients.[6,12,17]

Rehabilitation and education are also recommended in TB patients to control the routine muscle function and functional capacity of the body, and it is recommended to follow a healthy lifestyle with optimal consumption of a balanced diet, to accelerate recovery. Some nutritional guidelines that are worth recommending to patients are following WHO recommendations.[6] Nutrition for TB patients is characterized by multiplying antioxidant substances and intake of specific nutrients such as vegetables, fruits, whole grains, legumes, and canola oil which is one of the sources of omega-3 by 11% with MUFA content of 65% and olive oil which is a source of MUFA 75% which also has omega-3 content but by 1%, as well as supplementation of micronutrients and omega-3.[5,6,12]

Conclusion

The treatment of medical therapy nutrition in TB patients depends on the difficulty and clinical condition of the patient. Total energy, percentage of proteins, fats and carbohydrates are adjusted to recommendations and clinical conditions. The administration of proteins is adapted to the function of the kidneys and hypercatabolic state, as well as clinical patients. Increased micronutrients need in TB patients were associated with poor intake, increased need for disease, and socioeconomic ability and side effects of anti-tuberculosis drugs. Micronutrients supplementation of vitamin B1, B6, folic acid, C, A, D, E, zinc according to recommended dietary allowances (RDA) and omega-3 specific nutrients with EPA 1 gram / day helps accelerate the recovery period of TB patients. The functional capacity of all three patients improved during treatment. After getting proper medical therapy nutrition, the situation is getting better until it recovers.

Conflict of Interest

Authors declared no conflict of interest regarding this article.

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References

1. World Health Organization. *Global Tuberculosis*.; 2017.
2. Ministry of Health of the Republic of Indonesia. National guidelines for tuberculosis control. *J Public health*. 2011:2011.
3. Lai H-H, Lai Y-J, Yen Y-F. Association of Body Mass Index with Timing of Death during Tuberculosis Treatment. Dowdy DW, ed. *PLoS One*. 2017;12(1)
4. Semba RD, Darnton-Hill I, de Pee S. Addressing tuberculosis in the context of malnutrition and HIV coinfection. *Food Nutr Bull*. 2010;31(4):S345-64.
5. Sinclair D, Abba K, Grobler L, Sudarsanam TD. Nutritional supplements for people being treated for active tuberculosis. Review:Update of *Cochrane Database Syst Rev*. 2011;(11)
6. Guideline: Nutritional care and support for patients with tuberculosis. *World Heal Organ 2013*.
7. Ministry of Health Republik Indonesia. National TB control strategy. 2016-2020. 2016
8. Singer P, Blaser AR, Berger MM, et al. ESPEN guidline on clinical nutrition in the intensive care unit. *Clin Nutr* 2018.
9. McClave SA, Taylor BE, Martindale RG, et al. Guidelines for the Provision and Assesment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society Of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N). *J Parenter Enter Nutr 2016*;40(2):159-211
10. Qian F, Korat AA, Malik V, Hu FB. Metabolic Effects of Monounsaturated Fatty Acids-Enriched Diets Compared With Carbohydrate or Polyunsaturated Fatty

Acid-Enriched Diets in Patients With Type 2 Diabetes: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Diabetes Care* 2016; 39(8): 1448-1457.

11. Junaid K, Rehman A. Impact of vitamin D on infectious disease-tuberculosis-a review. *Clin Nutr Exp*. 2019;25:1-10.
12. Grobler L, Nagpal S, Sudarsanam TD, Sinclair D. Nutritional supplements for people being treated for active tuberculosis. *Cochrane Database Syst Rev*. June 2016
13. Sathenahali VB, Minarey N, Gornale V, Kumar R, Joshi K, Association of Tuberculosis With Severe Acute Malnutrition. *J Evol Med Dent Sci* 2015; 4 (68):11865-11870.
14. Amaral EP, Costa DL, Namasivayam S, et al. A major role for ferroptosis in Mycobacterium tuberculosis-induced cell death and tissue necrosis. *J Exp Med.* 2019; 216 (3): 556-570.
15. Sola E, Rivera C, Mangual M, Martinez J, Rivera K, Fernandez R. Diabetes mellitus: an important risk factor for reactivation of tuberculosis. *Endocrinol Diabetes Metab Case Report* 2016.
16. Miwa K, Mitsuoka M, Takamori S, Hayashi A, Shirouzu K. Continous Monitoring of Oxygen Consumption in Patients Undergoing Weaning From Mechanical Ventilation. *Respiration* 2003; 70(6): 623-630.
17. Maggini S, Wintergerst ES, Beveridge S, Horniq DH. Selected Vitamin and trace elements support immune function by strengthening epithelial barriers and cellular and humoral immune responses 2019; (2007):29-35.