



Research Article

Review of Risk Factors of Malnutrition in Maintenance Hemodialysis Patients

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Abstract

This article reviews the iatrogenic (nutrient loss caused by dialysis, inflammatory reaction caused by dialysis, insufficient dialysis, and metabolic acidosis) and non-iatrogenic (patients' insufficient diet, taste change, poor appetite, and psychosocial function) risk factors for malnutrition in maintenance hemodialysis patients. The aim of this review article is to incorporate these aspects into the malnutrition risk assessment of maintenance hemodialysis

patients in order to enhance nutritional status, improve medical quality, and assure patient safety.

Keywords: Iatrogenic; Maintenance hemodialysis; Malnutrition; Non-iatrogenic factors; Review; Risk factors

Abbreviations: CRP: Creactive protein; DEI: Daily energy intake; DPI: Daily protein intake; ESRD: End stage

renal disease; HCT: hematocrit, IL: Interleukin; IR: Insulin resistance; Kt/V: Adequacy of dialysis; LP: lipoprotein; MA: Metabolic acidosis; Mia: Malnutrition inflammation atherosclerosis syndrome; MICs: Malnutrition inflammation complex syndrome; MHD: Maintenance Hemodialysis; PEW: Protein Energy Wasting; TNF: Tumor necrosis factor

1. Introduction

Malnutrition is frequent among hemodialysis patients, with 20 % to 70 % of those on maintenance hemodialysis patients [1-3]. Malnutrition is also known as Protein Energy Wasting (PEW), Malnutrition Inflammation Complex Syndrome (MICs) and Malnutrition Inflammation Atherosclerosis Syndrome (MIA) [4]. Malnutrition is a strong predictor of mortality and morbidity, as well as increased hospitalization rates, lower physical activity, poorer quality of life, and inadequate dialysis [5-7]. Severe malnutrition affects 6% to 8% of hemodialysis patients, while mild malnutrition affects 30% to 65 % of patients. Low dialysis adequacy has been identified as leading cause of malnutrition in hemodialysis patients [8]. Maintenance Hemodialysis (MHD) is the main alternative treatment of End-Stage Renal Disease (ESRD) and it raise the quality of life, prolongs survival and decreases complications. MHD involves manually removing toxins such as metabolic waste in the blood from the body [9]. MHD replaces the kidney to remove metabolites in the body but has not fully achieved the effect of normal kidney on human metabolites. ESRD patients still have the continuous accumulation of metabolic waste after MHD treatment. To a certain extent, they are prone to malnutrition, metabolic disorder and other

complications [10]. Kalantar zadehk et al. [11] proposed protein energy malnutrition in 2003, and inflammation are generally frequent in MHD patients. This article aims to review the related influencing factors of malnutrition in these patients. It is hoped that it will provide a reference basis for the clinical prevention and treatment of malnutrition.

2. Factors contributing the development of Malnutrition

2.1. Iatrogenic factors of malnutrition in maintenance hemodialysis patients

2.1.1. loss of nutrients caused by dialysis.

Long term hemodialysis will lead to the loss of nutrients, especially amino acids and proteins. Each dialysis process will lead to the loss of 6 ~ 12g amino acids and 7 ~ 8g protein [12, 13]. Protein catabolism will rise when amino acids are lost, resulting in muscle protein hydrolysis throughout the patient's body. Hypoproteinemia raises the risk of malnutrition and patient death [14,15]. The amount of nutrients lost as a result of dialysis is determined by the process of solute removal and the membrane pore size. The pore size of the dialysis membrane controls how much solute is removed, however increasing the pore size might remove larger molecules of toxins and cause more nutrients to be lost [16]. The degree of amino acids, peptides, proteins and other nutrients lost from dialysate is related to dialysis method, dialysis time, dialysis frequency and blood flow, especially high-throughput dialysis membrane, which increases the incidence of hypoproteinemia and leads to malnutrition in MHD patients. Interception dialyzer can significantly improve the dialysis effect, appetite and body mass index of patients, but these membrane materials will also cause patients to lose more protein, amino acids and

vitamins [17]. To summarize, researchers should focus not only on the removal of medium macromolecular toxins by large pore size membranes for maintenance hemodialysis patients, but also on balancing the pore size of the membrane and preventing patients from losing nutrients.

2.1.2 Micro inflammatory state

Before starting dialysis, MHD patients have a micro-inflammatory state, which is accompanied by a considerable increase in inflammatory markers. Dialysis causes inflammation due to a variety of variables including a dialyzer membrane with poor biocompatibility, infection in the dialysis channel, and dirty dialysate. Non-iatrogenic factors of malnutrition in maintenance hemodialysis patients [18]. Under the stimulation of microorganisms, endotoxin, various chemicals, complement, and immune complex, a micro inflammatory state [19, 20] refers to a slow and persistent minor inflammatory reaction centered on the activation of the monocyte macrophage system and the release of related pro-inflammatory cytokines. It is defined by a gradual and ongoing increase in inflammatory marker protein and inflammatory cytokines in the systemic circulation with no clear clinical symptoms, resulting in a non-dominant inflammatory state in patients with varied problems. It is persistent and largely unnoticed. It's not the same as a microbial infection. It is, at its core, an immunological state. C-Reactive Protein (CRP), Lipoprotein (a) [Lp (a)], Interleukin-1 (IL-1), Interleukin-6 (IL-6) and Tumor Necrosis Factor (TNF) are the primary factors involved in the inflammatory state [21]. In vitro experiments showed that TNF - α , Inflammatory factors such as IL-1 and IL-6 can lead to increased protein decomposition [22]. High levels of IL-6 and TNF in serum

will increase the catabolism of muscle protein. The transcription factor kappaB (NF kappaB) activated by TNF is considered to be an intermediary factor of skeletal muscle protein consumption [23].

2.1.3 Multiple dialyzer reuse

Dialyzer reuse is very widespread in underdeveloped and developing countries [24, 25]. Multiple dialyzer reuse, on the other hand, may result in undesirable results [26], including; infection risks, biochemical and immunologic reactions, insufficient sterilization, and increased membrane permeability.

2.1.4 Metabolic acidosis

In MHD patients, Metabolic Acidosis (MA) is a major cause of malnutrition. In individuals with ESRD, MA is a prevalent acid-base metabolic imbalance. The ability of the kidney to produce ammonia and eliminate hydrogen ions reduces as renal function deteriorates, resulting in the emergence of MA. MA cannot be entirely corrected with regular hemodialysis. MA has a negative impact on protein and muscle metabolism, as well as the onset and progression of renal osteodystrophy [27-29]. According to the study, patients with bicarbonate levels ≤ 22 mmol / L were associated with serum albumin levels ($r = 0.432$, $P = 0.019$) [30]. Because malnutrition is a confounding factor of serum bicarbonate level, no ideal serum bicarbonate level can meet all dialysis patients. Correcting MA in MHD patients is an essential goal of dialysis treatment, as it helps to avoid and treat malnutrition in MHD patients.

2.1.5 Adequacy of dialysis

The adequacy of dialysis, which relates to the frequency and duration, determines the solute clearance rate of maintenance hemodialysis patients. The urea clearance index (kt / V) is currently used to assess the effectiveness of dialysis. Dwyer et al. [31] studied 1846 dialysis patients over the course of three years. The study demonstrated that MHD patients with $kt / V > 1.2$ had higher nutritional status than those with $kt / V < 1.2$ ($P < 0.05$). The nutritional indicators serum albumin (ALB), hematocrit (HCT), and hemoglobin were favorably connected with $kt / V > 1.2$ in MHD patients.

3. Non iatrogenic Factors of Malnutrition in Maintenance Hemodialysis Patients

3.1 Insufficient intake of nutrients

Insufficient dietary intake is the main cause of malnutrition in maintenance hemodialysis patients, according to the literature, resulting in a considerable increase in patient mortality [4, 11]. To avoid the risk of malnutrition, the daily protein intake (DPI) of maintenance hemodialysis patients should be 1.0~1.2g/kg and the Daily Energy Intake (DEI) should be 104.6~146.5kj/kg, according to the guidelines [32-34]. Many studies have found that 70% to 90% of maintenance hemodialysis patients consume insufficient protein on a daily basis [35,36], while 30% to 80% of maintenance hemodialysis patients consume insufficient energy [37,38]. Monotonous eating habits [35], low dietary quality [36], anorexia [36], and taste alteration [39] are the primary causes of suboptimal nutrient intake in maintenance hemodialysis patients. Malnutrition can result from a lack of nutrients, as well as a problem with the

synthesis of trace elements like niacin, folate, calcium, phosphorus, zinc and dietary fiber [36]. Therefore, maintaining adequate protein and energy intake is an important factor to avoid malnutrition in patients.

3.2 Taste change

Lynch et al. [40] studied 1745 maintenance hemodialysis patients and discovered that 34.6 percent of them had taste alterations, that their serum albumin levels and dry weight were low, and also that their daily calorie intake was less than that of the non-change group. Studies have also shown that maintenance hemodialysis patients have an increased intolerance to high-protein meals like meat, lowering the quality of their diet and potentially leading to anorexia and malnutrition [41].

3.3 Poor appetite

Insufficient diet raises the risk of malnutrition, which is a direct effect of reduced appetite. Maintenance hemodialysis patients with poor appetite have a 4.74-fold increase in hospitalization frequency, length of stay, quality of life, and nutritional status, as well as a 4.74-fold increase in mortality [39]. DPI and Dei were considerably lower in patients with poor appetite and good appetite than in patients on maintenance hemodialysis ($P = 0.010$ and $P = 0.049$, respectively) according to Sahathevan et al. [37].

3.4 Insulin resistance

MHD patients exhibited obvious Insulin Resistance Resistant (IR), according to Siew and colleagues [42], and non-dialysis patients had significant IR as well. Skeletal muscle protein breakdown and protein metabolism disorders are linked to IR. It is thought to be a novel target

for treating dry weight loss and protein deficiency in MHD patients. The causes of IR in non-diabetic dialysis patients are unknown, however they could be connected to central adiposity, a micro-inflammatory state, or other metabolic abnormalities. In non-diabetic MHD patients, the degree of IR is thought to predict protein catabolism [32, 43]. Therefore, the intervention of IR plays a certain function in the prevention and treatment of malnutrition in MHD patients.

3.5 Social psychological factors

In HD patients, psychosocial variables may deleterious effect on their physical and emotional well-being, quality of life, and nutritional status.

3.5.1 Depression

According to study, depression affects 6 % to 84 % of maintenance hemodialysis patients [44]. Patients with depression experience job loss, a lack of social support, weakness, and impaired cognitive performance. There is a link between depression and starvation, according to other studies. The higher the depression score, the higher the creatinine and inflammatory indexes, as well as lower serum albumin and hemoglobin levels [45]. The nutritional indicators of maintenance hemodialysis patients were dramatically improved when they were treated with antidepressants [46]. Some researchers believe that depression is an important risk factor for malnutrition. Finally, assessing and treating depression in maintenance hemodialysis patients is a critical connection in the fight against malnutrition.

3.5.2 Lack of Social support

Most patients lack friends, family, and social support as a result of the disease's long course [47]. Long-term social isolation causes anorexia and poor treatment adherence [48], leading in malnutrition. The study discovered that maintenance hemodialysis patients without social support had a blood albumin level of less than 35 mg/L [or = 1.18, 95 percent CI (1.02, 1.37)]. [49]. Patients who receive good social support are more likely to return to society, have more confidence in their ability to cope with diseases, have less depression, and have a better nutritional state.

3.5.3 Financial Constraints

Hemodialysis patients frequently encounter financial strain as a result of treatment and treatment time investment. Patients' self-efficacy in health management is reduced by poverty, as is their consumption of nutrients [50]. The DEI of employed maintenance hemodialysis patients was over and above than that of jobless patients ($P > 0.01$), according to the study. In a study of 344 maintenance hemodialysis patients in Brazil, Freitas et al. [51] discovered that low-income patients had a greater frequency of malnutrition and had higher malnutrition ratings. Prior to starting HD treatment, 51% of 231 Chinese working-age HD patients were employed, but this dropped to 11% after starting treatment [52]. The dialysis regimen and post-dialysis exhaustion were cited as important factors for unemployment by these patients.

3.5.4 Decreased Physical Functioning

Patients on maintenance hemodialysis become exhausted as their physical function deteriorates. Sarcopenia, vascular dysfunction, inflammation, and malnutrition are

comorbidities [53] associated with CKD that have a negative impact on the three elements of physical functioning [54], which are associated to bodily functions and structure, performance ability, and physical activity engagement. Fatigue is a major factor in patients' physical quality to execute everyday activities, and it also contributes to malnutrition. It has been observed that fatigue after dialysis causes a drop in dietary compliance in 59 % of maintenance hemodialysis patients, and that the decline of physical function is substantially connected with DEI ($r = 0.125$, $P = 0.002$) [55]. Other research has found that malnourished maintenance hemodialysis patients had a reduced capacity to do everyday tasks [56].

4. Conclusion

In this review article, we provided a comprehensive review of the risk of malnutrition in the HD group as having iatrogenic or non-iatrogenic causes. The nutritional status of maintenance hemodialysis patients can be enhanced by early identification of risk factors. Malnutrition is common among maintenance hemodialysis patients. Malnutrition in hemodialysis patients causes fatigue, lowers patient quality of life, and increases infection and fatality risks. In clinical work, the above related risk factors leading to malnutrition in MHD patients can be integrated to provide some ideas for the prevention and treatment of malnutrition in dialysis patients. The first step in determining the cause of malnutrition is to conduct a nutritional assessment. Early identification of iatrogenic and non-iatrogenic risk factors for malnutrition is important. It can create individualized patient intervention methods, provide multidisciplinary

nursing care, enhance nutritional status, and reduce complications.

Ethics in publishing

Human and animal rights this is to inform you that this review article do not involve the use of human subjects or experiments involving humans and animals. No harm has been done to animals and humans or provided any drugs, or caused any physical, mental or social harm.

Declaration of interests

There are no competing interests regarding this review article.

Submission declaration

This is to ensure that this review article has not been published previously.

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