CHAPTER 1

Introduction

Rationale

Chronic kidney disease (CKD) is defined as kidney damage or decreased kidney function in which the glomerular filtration rate (GFR) is less than 60 mL/min per 1.73 m^2 for three months or more (1). The clinical features in CKD due to deterioration of renal function include anemia, fluid buildup in the tissues, loss of bone minerals, hypertension, fatigue, shortness of breath, loss of appetite, restlessness, change in urination patterns, and overall malaise (1, 2).

Utaka et al. (3) found that inflammation was associated with increased resting energy expenditure (REE) in CKD patients; however, the mechanisms involved in high REE were not fully identified. It is known that metabolic disorders were involved with inflammatory response induced fever (4), elevated oxygen consumption (VO_2) (4), enhanced lipolysis and fat utilization (5), elevated concentration of catabolic hormones and extensive protein catabolism (6). The importance of these findings is related to the deleterious effects of a sustained elevated REE. Moreover, its negative effects on nutritional status and increased REE have been associated with a high rate of mortality in patients who receive dialysis (3). Previous studies (7, 8) found that energy expenditure increases in association with hemodialysis procedure; this may be due to the negative nitrogen balance that could result from amino acid loss in dialysate and from increased protein catabolism. In additional, the dialysis procedure may remove the fuel substrates, such as amino acids, peptides, glucose metabolites (i.e., pyruvate and lactate) (7, 8). All of the foregoing factors might be expected to increase energy expenditure and the dietary requirement for energy sources (9). A limited number of studies have been conducted to evaluate the level of energy expenditure in CKD patients. Monteon et al. (9) studied an energy expenditure of 10 clinically stable predialysis patients, 16 hemodialysis patients, and 12 healthy control subjects. The results showed that REE of CKD patients was not different from that of healthy subjects. In contrast, a study by Ikizler et al. (10) showed that the REE of hemodialysis patients were significantly higher on nondialysis days when compared with healthy controls. Moreover, a study by Ikizler et al. (11) showed an increase in energy expenditure during hemodialysis, and energy increases may be due to the increased protein turnover (11). Therefore, the results of REE in hemodialysis patients are still controversial.

Hemodynamic risk factors in CKD patients are related to volume and pressure overload of the cardiovascular system. Fluid retention is a major clinical problem in individuals with advanced CKD, also known as stage 5 CKD or end stage renal disease (ESRD) (12). ESRD is the point in kidney failure when has been lost, rendering the body incapable of maintaining proper fluid and electrolyte balance, adequate waste removal, and normal hormonal function (13). Kalantar-Zadeh et al. (14) found that hemodialysis patients who have high levels of fluid retention (> 1.5 kg of fluid) are associated with higher risk of cardiovascular death. Patient responses during hemodialysis still remain a significant problem in any chronic dialysis program, including hypotension, hypertension, pulmonary edema, and headaches (15). According to the hemodialysis procedure, not only a waste product, but also retention water, was removed. Therefore, the hemodynamic changes that occurred during hemodialysis may be related to a reduction in central blood volume.

Although previous studies found the effects of hemodialysis on REE and hemodynamic changes in CKD patients, there is no study that has evaluated the hemodynamic and REE changes during hemodialysis in CKD patients. The knowledge of those processes may be useful for designing an exercise program and recommending food during a hemodialysis procedure. Therefore, the purpose of this study is to investigate the effects of hemodialysis on REE and hemodynamics among pre-, during, and post-hemodialysis in CKD patients.

Purposes and hypotheses of the study

1. Research question

Are there any differences in resting energy expenditure and hemodynamics among pre-, during and post-hemodialysis treatment in chronic kidney disease patients?

2. Hypothesis

1. There would have differences in resting energy expenditure among pre-, during, and post-hemodialysis.

2. There would have differences in hemodynamics among pre-, during, and post-hemodialysis.

3. Purpose

The purpose of this study was to investigate the effects of hemodialysis on resting energy expenditure and hemodynamics among pre-, during, and post-hemodialysis in chronic kidney disease patients.

4. Advantages of the study

The results of this study can be used as preliminary data, may be useful for basic knowledge, and may contribute to understanding hemodynamics and metabolism during hemodialysis.