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Original article

ASSESSING THE CORRELATION BETWEEN VISCERAL FAT AREA AND PERITONEAL DIALYSIS IN A CLINICAL CONTEXT: A PROSPECTIVE STUDY.

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Abstract.

Aim:

In this prospective study, the sequential alterations in adipose tissue composition and nutritional status were examined. Also, the factors linked to the increase in adipose mass among patients undergoing peritoneal dialysis (PD) was analysed.

Methods:

The evaluation of body composition was conducted using bioelectric impedance analysis (BIA) and computed tomography (CT) imaging techniques. The evaluation of the individual's nutritional status was conducted using the Subjective Global Assessment (SGA), protein equivalent of nitrogen appearance (nPNA), serum albumin levels, C-reactive protein (CRP) levels, and lipid profile. All measurements, with the exception of Bioelectrical Impedance Analysis (BIA), were conducted on the seventh day and at 6 and 12 months following the initiation of Peritoneal Dialysis (PD).

Results:

A total of 60 participants were recruited for the study. There was a progressive rise in body weight observed over the course of 12 months. Individuals who exhibited a higher quantity of visceral adipose tissue at the initiation of peritoneal dialysis experienced a reduced accumulation of visceral adipose tissue within the initial 6-month period (correlation coefficient = -0.821, p-value = 0.002). Patients with a higher initial subcutaneous fat mass demonstrated a lower increase in subcutaneous fat mass (correlation coefficient = -0.709, p-value = 0.015) during the course of peritoneal dialysis (PD).

Conclusion:

Patients initiating peritoneal dialysis (PD) commonly encounter an increase in body weight, encompassing both visceral and subcutaneous adipose tissue, within the initial six-month period of commencing PD therapy.

Recommendation: Accumulation of visceral fat is recommended to be measured by magnetic resonance imaging or CT, which can distinguish fat from other tissues and allow the measurement of visceral and subcutaneous abdominal fat mass independently with high reproducibility.

Keywords: Visceral Fat Area, Dialysis, Peritoneal Dialysis, Submitted: 2023-09-15, Accepted: 2023-09-21

1. Introduction.

The nutritional status is a critical determinant impacting the rates of mortality and morbidity

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among individuals undergoing chronic dialysis [1]. One of the adverse effects associated with peritoneal dialysis (PD) is an increase in adipose tissue mass. Multiple studies have documented alterations in body composition among individuals diagnosed with Parkinson's disease, encompassing variations in adipose tissue distribution throughout the body [2–4]. The adipose tissue has gained recognition as a crucial homeostatic and metabolic endocrine organ in recent medical and academic research. Specifically, the accumulation of visceral fat mass has been found to have a stronger correlation with the development of metabolic syndrome and atherosclerosis compared to subcutaneous fat mass. This association holds true for individuals who are both obese and of normal weight [5]. Visceral adipose tissue exhibits the propensity to amass and release a diverse array of cytokines, irrespective of the presence or absence of renal dysfunction. Moreover, the alteration in visceral adipose tissue mass serves as a more dependable prognostic indicator for survival among individuals diagnosed with Parkinson's disease [6].

Visceral adipose tissue is purportedly highly associated with cardio-metabolic risk factors and insulin resistance, and serves as a robust independent prognosticator of overall mortality in the general populace. In recent years, there has been a growing body of evidence indicating that an elevated visceral fat area (VFA) among Japanese individuals undergoing hemodialysis is a significant predictor of cardiovascular mortality [3]. While the association between visceral fat area (VFA) and cardiovascular risk factors or diseases has been acknowledged in Chinese individuals undergoing peritoneal dialysis (PD), it has been reported that visceral obesity does not serve as a prognostic indicator for poor outcomes in Korean PD patients. Furthermore, the specific connections between VFA and cardiovascular risk factors or diseases in Japanese PD patients have not been fully elucidated [4, 5].

Based on the findings of the National Family Health Survey conducted in India, it has been observed that there has been a notable rise in the proportion of ever-married women aged 15-49 years who exhibit excessive body weight or obesity. Specifically, the prevalence of overweight or obese individuals within this demographic has escalated from 11% to 15% over the course of two consecutive National Family Health Survey studies. Hence, the impact of visceral fat on the prognosis of Asian patients with Parkinson's disease remains a subject of debate within the medical and academic communities. Furthermore, the augmentation of visceral adipose tissue in individuals diagnosed with Parkinson's disease following the commencement of treatment has been elucidated in various scholarly investigations [6].

In the present study, serial changes in fat composition and nutrition status, and factors associated with gain of fat mass in patients undergoing PD was prospectively examined.

2. Materials and Methods.

2.1. Study design and population.

The data of patients who initiated and sustained continuous ambulatory and automated peritoneal dialysis for a minimum duration of 6 months at a tertiary care hospital were prospectively gathered. A total of 60 participants were recruited and enrolled in the study over a period of approximately three years.

2.2. Eligibility Criteria.

The exclusion criteria encompassed individuals below the age of 18, those with an existing malignancy, and individuals with a life expectancy of less than 6 months following the initiation of peritoneal dialysis.

2.3. Data Collection.

Baseline data, encompassing demographic characteristics such as age and gender, as well as clinical parameters like body weight, pre-existing renal conditions, and the existence of concurrent ailments such as diabetes mellitus (DM), hypertension, and cardiovascular disease, were systematically gathered. The measurement of body weight was conducted subsequent to the introduction of 2 litres of dialysate into the abdominal cavity. Cardiovascular disease was characterised by the

manifestation of coronary artery disease, congestive heart failure, cerebrovascular accident, or peripheral vascular disease. The body mass index (BMI) was computed using the formula BMI = weight (kg)/height (m^2).

2.4. Statistical Analysis.

All data are presented as the mean and standard deviation, unless otherwise indicated. Statistical disparities were assessed using the Student's t-test, chi-square test, Pearson's correlation, and general linear model (GLM)- repeated measure ANOVA, as deemed appropriate. A p-value of 0.05 was deemed to be statistically significant in the medical and academic context. All statistical calculations were conducted using SPSS 14.0 software (SPSS Inc., Chicago, IL, USA).

3. Results.

Among the cohort of 60 participants, consisting of 30 male individuals, the average age was found to be 55.0±12.4 years. At the initial stage a number of 200 patients were examined for eligibility, however 140 patients were excluded from this study due to not being eligible. A total of 25 patients (41.7%) were diagnosed with diabetes, while 24 patients (40%) presented with cardiovascular disease. In the study population, 9 individuals presented with coronary heart disease, 1 individual exhibited congestive heart failure, 6 individuals experienced cerebrovascular accidents, 6 individuals were diagnosed with multiple coexisting diseases, 1 individual presented with peripheral vascular disease, and 1 individual exhibited atrial fibrillation [Table 1].

The study findings indicate that there were notable differences in weight, intracellular fluid, extracellular fluid, protein mass, and mineral mass between males and females. Specifically, men exhibited higher values in these parameters compared to women. The adipose tissue, particularly the subcutaneous adipose tissue, exhibited higher levels in females compared to males. In the study, it was observed that women exhibited higher hematocrit and serum cholesterol levels compared to men. Conversely, women displayed lower levels of serum creatinine. There were no significant differences observed in the edoema index, mean arterial pressure (MAP), and subcutaneous fat thickness (SFT) between the male and female participants. At the onset of the study, there were no discernible disparities in body composition, anthropometric measurements, or laboratory findings between individuals diagnosed with diabetes mellitus and those without DM, with the exception of serum albumin levels. It is worth noting that serum albumin levels were comparatively lower in patients with DM in comparison to patients without DM, although specific results are not presented in this context. The study observed a progressive increase in fat mass, particularly visceral fat mass, as individuals advanced in age. Body weight, intracellular fluid volume, extracellular fluid volume, protein mass, mid-arm circumference (MAC), and skinfold thickness exhibited a negative correlation with advancing age. The levels of serum blood urea nitrogen (BUN) and creatinine exhibited a decline with the progression of ageing. The study findings indicate that there was a significant association observed between serum triglyceride levels and both visceral and subcutaneous fat mass.

The subjects who exhibited a higher initial quantity of visceral fat mass at the commencement of peritoneal dialysis experienced a comparatively lower increase in visceral fat mass over the course of the initial six-month period (correlation coefficient = -0.821, p-value = 0.002). The individuals who exhibited higher levels of subcutaneous adipose tissue at the commencement of peritoneal dialysis experienced a reduced increase in subcutaneous adipose tissue mass within the initial 6-month period (correlation coefficient = -0.709, p-value = 0.015). Conversely, these individuals demonstrated a greater increase in subcutaneous adipose tissue mass during the subsequent 6-month period (correlation coefficient = 0.676, p-value = 0.022). The subjects who experienced a higher increase in subcutaneous adipose tissue mass within the initial half-year period exhibited a more substantial reduction in subcutaneous adipose tissue mass during the subsequent half-year period ($r = -0.818$, $p = 0.002$). Addi-

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Table 1: **Patient Demographics**

Variables	Frequency	Percentage
Diabetes Mellitus	25	41%
CVD	24	40%
Age	55.0±12.4 years	
BMI	23.3±3.0 kg/m^2	
Weight	61.4±10.3 kg	
Height	162.0±10.3 cm	
HbA1C	5.8%±1.1%	
Hematocrit	31.2%±4.3%	
Triglyceride	111.7±83.5 mg/dL	
Cholesterol	149.1±44.4 mg/dL	
Albumin	3.9±0.5 g/dL	
Creatinine	8.5±2.7 mg/dL	

tionally, these individuals demonstrated a lower degree of weight gain during the latter half-year period ($r = -0.619$, $p = 0.042$).

4. Discussion.

In the current investigation, the observed phenomenon entailed a progressive elevation in bodily mass over a span of 12 months. Notably, the accumulation of adipose tissue within the visceral and subcutaneous regions exhibited an upward trend during the initial half-year, followed by a subsequent decline in the latter half-year. The levels of serum creatinine, total cholesterol, and triglycerides exhibited a parallel increase in accordance with the observed weight pattern. During the initial half-year period, there was a notable decline observed in both hematocrit levels and serum albumin concentrations. However, these parameters exhibited no significant alterations throughout the subsequent six-month duration. The presence of diabetes mellitus, advanced age, and the utilisation of high glucose dialysate did not exhibit any discernible impact on alterations in body weight, visceral adipose tissue mass, or subcutaneous adipose tissue mass. Exclusively male individuals exhibited a greater increase in body weight during the latter half of the six-month period.

An elevation in adipose tissue is a prevalent observation among individuals undergoing peritoneal dialysis, a medical procedure associated with an augmentation in adiposity [7–9]. Obesity is a well-established risk factor for overall mortality. Nevertheless, Ramkumar et al. [10] demonstrated that newly diagnosed patients undergoing peritoneal dialysis with a high body mass index and normal or elevated muscle mass exhibit the most favourable survival outcomes.

The findings presented in this study are incongruous with the research conducted by Vasselai et al. [11], which demonstrated no statistically significant alteration in body weight or adipose tissue mass over the course of a 12-month observational period. The research encompassed a cohort of patients, comprising 31.3% of the total population, who had undergone hemodialysis treatment as their initial modality for dialysis. The median duration of hemodialysis therapy in this group was 14 months. While certain investigations have posited the significance of glucose absorption in relation to adipose tissue accumulation, our findings did not yield any correlation between the utilisation of high glucose dialysate and weight or adipose gain [12–15]. This observation aligns with prior studies wherein the accumulation of adipose tissue was found to be correlated with overall energy intake rather than the consumption and absorption of glucose [16].

Although there was no significant alteration in total Kt/V, there was a notable decrease in nor-

malised protein nitrogen appearance, which exhibited an inverse relationship with both body weight and creatinine levels. The hematocrit and serum albumin levels exhibited a decline during the initial half-year period, but remained stable during the subsequent six-month duration. The dermal fold thickness exhibited a progressive increase over a span of 12 months, mirroring the observed weight trajectory. The findings of this study were incongruent with the research conducted by Vasselai et al. [11] and Jager et al. [12]. The research conducted encompassed a smaller cohort of individuals diagnosed with diabetes mellitus, comprising less than 20% of the total study population. Vasselai et al. [11] incorporated individuals who had undergone hemodialysis treatment prior to initiating peritoneal dialysis in their study cohort. Our observations yielded a duration that was shorter compared to the findings reported by Jager et al. in their study [12].

Although there was a variation in baseline total cholesterol levels based on gender, there were no significant differences observed in baseline triglyceride levels. The levels of total cholesterol and triglycerides exhibited an increase over the course of the 12-month period. The study findings indicate a significant correlation between the initial triglyceride levels and the initial amounts of visceral and subcutaneous fat mass. However, no significant correlation was observed between the initial total cholesterol levels and the aforementioned fat mass. These findings are consistent with previous studies [13]. Cheng et al. conducted a study wherein they observed that levels of triglyceride and total cholesterol in patients without diabetes or obesity, who initiated peritoneal dialysis, exhibited an increase after a duration of one year [16].

C-reactive protein has been identified as a notable and autonomous prognostic factor for cardiovascular events and patient survival in individuals undergoing peritoneal dialysis. However, it is worth noting that CRP levels did not exhibit any significant elevation and were not found to be associated with alterations in body fat composition. These findings are in line with the study conducted by Vasselai et al. [11]. The potential influence of malnutrition among select patients in the current study may have rendered C-reactive protein (CRP) findings inconsequential. Further research is warranted to explore the correlation between visceral adiposity and C-reactive protein (CRP) levels.

Several studies have demonstrated that central adiposity is a robust indicator of the presence of atherosclerosis and dyslipidemia in individuals receiving dialysis treatment [7–10]. In the findings of our study, a significant correlation between the initial levels of visceral fat and subcutaneous fat mass with dyslipidemia and anthropometric indicators was observed. In the context of adipose tissue distribution, it was observed that weight, fat mass, and skinfold thickness exhibited a stronger correlation with subcutaneous fat deposition compared to visceral fat mass. Conversely, body mass index and mid-arm circumference demonstrated a higher correlation with visceral fat mass. These findings are in accordance with a study conducted by Sanches et al. [17]. The findings of our study indicate that there was a significant increase in both visceral fat and subcutaneous fat within the initial 6-month period subsequent to the initiation of peritoneal dialysis. However, it is noteworthy that these fat deposits did not exhibit any notable changes during the subsequent 6-month period. However, the change in weight (ΔW) did not exhibit any significant correlation with the changes in volume (ΔV) or surface area (ΔS) over the course of the initial or subsequent six-month periods.

5. Conclusion.

In summary, the subjects exhibited a notable augmentation in body mass, encompassing both visceral and subcutaneous adipose tissue, within the initial half-year period subsequent to commencing peritoneal dialysis. Individuals presenting with elevated initial fat mass exhibited a comparatively lower degree of fat mass augmentation when compared to those with lower initial fat mass, irrespective of whether the augmentation occurred in the visceral or subcutaneous adipose tissue compartments.

6. Limitations.

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

7. Recommendation.

Accumulation of visceral fat is recommended to be measured by magnetic resonance imaging or CT, which can distinguish fat from other tissues and allow the measurement of visceral and subcutaneous abdominal fat mass independently with high reproducibility. The authors recommend that individuals receiving PD should be encouraged to enhance their muscle mass rather than accumulating fat mass.

8. Acknowledgment.

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9. List of abbreviations.

PD- peritoneal dialysis
BIA- bioelectric impedance analysis
CT- computed tomography
SGA- Subjective Global Assessment
nPNA- Normalized protein nitrogen appearance
CRP- C-reactive protein
MRI- magnetic resonance imaging
VFA- visceral fat area
DM- diabetes mellitus
BMI- body mass index
GLM- general linear model
ANOVA- Analysis of variance
SPSS- Statistical Package for The Social Sciences
MAP- mean arterial pressure
SFT- subcutaneous fat thickness
MAC- mid-arm circumference
BUN- blood urea nitrogen

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11. Conflict of interest.

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