

Relationship of Albumin Concentrations with Sodium, Potassium, in CAPD (Continuous Ambulatory Peritoneal Dialysis) Patients at PHC Hospital Surabaya

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Abstract

Kidney failure is caused by a permanent decline in kidney function and requires renal replacement therapy, one of which is Continuous Ambulatory Peritoneal Dialysis (CAPD). This study aimed to determine the relationship between albumin concentrations and sodium and potassium concentrations in CAPD patients. The study was carried out between January to May 2022. Cross-sectional research methodology is used in this study. It included 60 chronic kidney failure patients who had CAPD as therapy at PHC Surabaya Hospital. Then, patients were divided into three groups with an age interval of 40-50 years, 51-60 years, and 61-70 years in. The results of grouping CAPD patients according to the characteristics based on the age of CAPD patients aged 61-70 years had low albumin concentrations and low sodium concentrations A total of 12 people (66.67%), patients with large CAPD aged 51-60 years, had low albumin and potassium concentrations, namely 11 people (61.11%). CAPD patients aged 51-60 years mostly had low albumin and sodium concentrations in 13 people (72.22%). the conclusion is that in patients with renal failure on CAPD therapy, there is a decrease in albumin and sodium-potassium concentrations due to peritonitis (inflammation) which is associated with a measurable excess of fluid (overhydration) which causes more dilute sodium, causing hyponatremia and hypokalemia.

Keywords

Albumin, Continuous Ambulatory Peritoneal Dialysis, Potassium, Sodium.



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INTRODUCTION

Kidney failure or End Stage Renal Disease (ESRD) is caused by a gradual decline in kidney function. ESRD requires therapy for renal replacement with interventional kidney transplantation or dialysis. Dialysis can be done with hemodialysis (HD) and CAPD (*Continuous Ambulatory Peritoneal Dialysis*) (1). The number of active patients having kidney replacement therapy worldwide in 2018 was 132,142, or 499 per million people, according to data from the Indonesian Renal Registry (IRR), with an increase in patients undergoing renal replacement therapy of 66,433, or 251 per million people. This number has gone up. In comparison to the prior year, it nearly doubled (2). Meanwhile, in 2015 East Java ranked 4th after Central Java for cases of kidney failure requiring dialysis therapy (3). This shows that every year there is an increase in patients with kidney failure on dialysis. Kidneys have an essential function in homeostasis, namely removing metabolic waste, maintaining fluid and electrolyte balance, and producing hormones that can affect other organs; one example is blood pressure control (4). Peritonitis in CAPD more often comes from micro-contamination of organisms on the skin during fluid replacement dialysate, contamination during catheter change, bacterial colonization at exit sites and tunnel infections.

CAPD (Continuous Ambulatory Peritoneal Dialysis) is a dialysis technique performed with the peritoneal membrane (abdominal cavity), which functions as a filter, namely the peritoneal membrane (abdominal cavity membrane). Therefore, CAPD is often called "dialysis" through the stomach as a dialysis membrane that separates the dialysate fluid and blood plasma in the peritoneal cavity from the peritoneal blood vessels during CAPD (5). Blood is transferred using a machine and tubing. The water and garbage are subsequently removed using a filter. Along with fresh fluid, the blood is reintroduced to the body. In general, this treatment is carried out from 12 to 24 hours a day. In addition, it qualifies as ambulatory since the patient still removes urea and extra fluid during dialysis and maintains the electrolyte balance that CKD patients experience (6). In the CAPD process, the dialysate fluid can be changed up to 3-4 times a day. The composition of this dialysate fluid is differentiated according to the type of osmotic, buffer, and electrolyte (2). Treatment of kidney failure with CAPD can be done every day (7).

Serum albumin concentrations strongly predict an increased risk of morbidity and death in peritoneal dialysis (CAPD) patients. The amount of albumin in the body and serum albumin concentration is determined by several factors, including liver albumin

synthesis (which is influenced by diet), protein intake), protein catabolism, and extravascular distribution of albumin, in addition to these factors. Because the protein leaks into the peritoneal effluent in CAPD patients, the serum albumin concentrations are vulnerable to adverse effects. Patients with hypokalemia had lower serum albumin concentrations than those without hypokalemia, and serum albumin concentrations correlated significantly with serum potassium concentrations (8).

According to research by Riyadi et al., (9), the body's electrolyte alterations in chronic kidney failure are associated to hypertension. The levels of sodium and potassium can have an impact on the patient's blood pressure. Inhibiting renin secretion prevents angiotensinogen from being converted into angiotensin I, which is one of multiple ways that higher potassium concentrations might lower blood pressure. Second, decreased aldosterone secretion due to elevated potassium concentrations can result in a reduction in intravascular fluid due to sodium release.

A higher risk of morbidity and mortality in peritoneal dialysis (CAPD) patients is substantially predicted by serum albumin concentrations. The production of albumin by the liver (which is controlled by diet and protein intake), protein catabolism, and extravascular distribution of albumin are a few of the factors that affect serum albumin

concentration and albumin levels in the body. CAPD patients are susceptible to side effects on serum albumin concentrations because the protein is lost into the peritoneal effluent. Patients with hypokalemia had lower serum Hypoalbuminemia in patients with kidney failure is closely related to poor nutritional intake. The membrane used in the process of renal replacement therapy/dialysis can cause inflammation by activating white blood cells and increasing inflammatory mediators (10). Albumin is very important in these conditions. At the same time, the decrease in albumin concentrations in CAPD therapy patients can be caused by an increase in higher CAPD fluid concentrations so that excess water that will be removed with dialysate fluid is wasted and albumin concentrations in the blood are wasted, which can cause albumin to fall (11). There is a previous study on the description of albumin concentrations in CAPD patients, which stated that 80% of CAPD patients had albumin concentrations lower than the usual standard or Hypoalbuminemia (12).

Laboratory examinations carried out at the PHC Surabaya Hospital on patients with chronic kidney failure with CAPD therapy included Bun/Ureum, and Creatinine. Whereas in some cases on CAPD therapy, albumin and electrolyte concentrations were found the low. Examination of albumin and electrolytes is a *prognostic factor* that is also important to know in patients with renal

failure with hypertension. This study aims to determine the relationship between albumin concentrations and sodium and potassium concentrations in CAPD patients. The provisional hypothesis in this study is that there is a relationship between albumin concentrations and sodium-potassium in CAPD patients.

MATERIALS AND METHODS

Study Design and Participants

The types of research in this study are analytical and cross-sectional. The population in this study was patients with kidney failure with CAPD therapy at the PHC Surabaya hospital. The sample for this study was 60 samples that were determined with purpose sampling using the Slovin formula (13). The inclusion criteria for samples are the 40-50 age group, the 51-60 age group and the 61-70 are group in CPAD patients. This research was carried out at PHC Surabaya's Laboratory of the Clinical Pathology in October 2021 - May 2022.

Data Collection and Measurements

The sample used was fresh serum obtained from total blood without anticoagulants and centrifuged at 3000 rpm for \pm 15 minutes at room temperature (14). The serum was measured using an ARCHITECT c4000 Clinical Chemistry Analyzer using the bromocresol green (BCG) method (AlbBCG). The intensity of this green colour indicates the concentrations of

albumin in the serum. The intensity of the colour produced is proportional to the concentration of albumin in the sample measured at a wavelength of 620 nm.

Examination of serum sodium and potassium concentrations obtained from serum that has been filtered and measured using a Caretium Medical Instruments with an Ion Selective Electrode (ISE) method. The principle of measurement is to calculate the ion content of the sample by comparing the unknown ion value with the known ion concentrations value (21)

In this study, primary data were collected by sampling patients receiving CAPD medication and by analyzing serum albumin, sodium, and potassium levels. Measurements of the data continued with albumin examination with the ARCHITECT c4000 Clinical Chemistry Analyzer and examination of Sodium and Potassium with the Caretium ISE method. Additionally, analytical processing will be done on the collected data. This research has received ethical approval from the hospital ethics committee PHC Surabaya with the number: 001/KEPK/RSPS-2022.

Statistical Analysis

The data obtained from this study was analyzed using SPSS (Statistical Product and Service Solutions) 26 program. The data obtained were processed using the Spearman Correlation statistical test to determine whether there was a relationship between

albumin concentrations with sodium and potassium in CAPD patients based on normal values/threshold values for each examination. The inspection data obtained were then analyzed using the Spearman correlation test. The Spearman correlation test is a statistical test aimed at knowing the relationship between two or more ordinary scale variables. Since the data are interval data, they are converted into the original data by categorizing according to the threshold for each variable. Including low, average, and three high categories (15).

RESULTS

The results of the analysis of the albumin, sodium, and potassium concentrations in CAPD patients between the ages of 40 and 50 who had examinations at the PHC Surabaya

Hospital's Clinical Pathology Laboratory are presented in Table 1. It shows that the average albumin concentration of CAPD patients aged 40 to 50 is 3.24 g/dl, while the sodium and potassium contents are 136.91 mmol/L and 3.72 mmol/L, respectively.

According to the age distribution of patients with CAPD had average albumin values of 3.24 g/dl, 3.0 g/dl, and 2.86 g/dl between the ages of 61 and 70. The average sodium concentration in CAPD patients aged 41 to 50 was 136.91 mmol/L, compared to 134.21 mmol/L for patients aged 51 to 60 and 134.19 mmol/L for those aged 61 to 70. In CAPD patients aged 41 to 50, the average potassium level was 3.72 mEq/L, 3.70 mEq/L in those aged 51 to 60, and 3.68 mEq/L in those aged 61 to 70.

Table 1. Results of Analysis of Albumin, Sodium and Potassium in Patients with CAPD Aged 40-50 Years

| | Mean | Min | Max | Std. Deviation |
|--------------------|-------|-------|-------|----------------|
| Albumin (g/dl) | 3.24 | 4.80 | 2.00 | 0.65 |
| Sodium (mmol/L) | 136.9 | 142.7 | 130.9 | 2.90 |
| Potassium (mmol/L) | 3.72 | 4.53 | 3.01 | 0.45 |

According to Table 1, CAPD patients between the ages of 40 and 50 tend to have low albumin concentrations as well as normal sodium and potassium concentrations. CAPD patients between the ages of 51 and 60 were tested for albumin, sodium, and potassium concentrations. According to the findings, the average sodium concentration was 134.2

mmol/L, the average potassium concentration was 3.70 mmol/L, and the average albumin concentration was 3.00 g/dl. This data indicated that patient is in normal condition. Normal sodium levels are usually between 136 - 145 mmol/L. Normal blood potassium levels were considered to be between 3.5 and 5.5 mmol/L.

Table 2. Results of Examination of Albumin, Sodium and Potassium in Patients with CAPD Aged 51-60 years

| | Mean | Min | Max | Std. Deviation |
|--------------------|-------|-------|-------|----------------|
| Albumin (g/dl) | 3.00 | 3.90 | 1.80 | 0.59 |
| Sodium (mmol/L) | 134.2 | 139.6 | 130.2 | 2.78 |
| Potassium (mmol/L) | 3.70 | 6.00 | 2.62 | 0.82 |

Table 2 reported that potassium and sodium concentrations are within normal ranges. Table 2 demonstrates that the average albumin concentrations in CAPD patients aged 51 to 60 years tend to be low. The average albumin, sodium, and potassium values in CAPD patients between the ages of 51 and 60 were lower than those between the ages of 40 and 50. According to a descriptive examination of CAPD patients aged 61 to 70, average albumin concentrations were 2.82 g/dl, sodium concentrations were 134.19 mmol/L, and potassium concentrations were 3.68 mmol/L.

According to Table 3, the findings of testing CAPD patients between the ages of 61 and 70 years old revealed that, on average,

albumin and salt concentrations tended to be lower than normal, but potassium concentrations were within normal ranges. In comparison to CAPD patients aged 40–50 years and 51–60 years, CAPD patients aged 61–70 years had lower average findings for albumin, sodium, and potassium concentrations.

The SPSS program's Spearman correlation test was then used to analyze the inspection data. The received data is transformed into ordinal data by categorizing in accordance with the threshold of each variable because the data are in the form of interval data. Table 4 demonstrates result from SPSS with details on the characteristic sample (gender, BMI, etc.).

Table 3. Results of Examination of Albumin, Sodium and Potassium in Patients With CAPD Aged 61 – 70 years

| | Mean | Min | Max | Std. Deviation |
|--------------------|--------|-------|-------|----------------|
| Albumin (g/dl) | 2.82 | 4.10 | 1.90 | 0.65 |
| Sodium (mmol/L) | 134.19 | 144.9 | 116.4 | 6.16 |
| Potassium (mmol/L) | 3.68 | 4.81 | 6.16 | 0.55 |

Table 4. Results of Data Analysis from SPSS

| Group | Variable A | Variable B | Sig | r |
|-----------------|------------|------------|-------|-------|
| 40-50 years old | Albumin | Sodium | 0.006 | 0.548 |
| | | Potassium | 0.042 | 0.418 |
| 51-60 years old | Albumin | Sodium | 0.045 | 0.478 |
| | | Potassium | 0.034 | 0.502 |
| 61-70 years old | Albumin | Sodium | 0.031 | 0.509 |
| | | Potassium | 0.045 | 0.478 |

Sig.(2-tailed) was used to determine Significance. If the value of Sig.(2-tailed) < 0.05 then the relationship contained in r is considered significant. It means that there is a relationship. Both variables are moderate/moderate and unidirectional between albumin concentrations and sodium and potassium concentrations. In the age group of 40-50 years, there is a strong and unidirectional relationship between albumin concentrations and sodium concentrations where the Sig value < 0.05 in the r correlation. In the age group 51-60 years, there was a moderate and direct relationship between albumin concentrations and sodium concentrations where the Sig value < 0.05 in the r correlation. In the 61-70-year group there is a strong and direct relationship between albumin concentrations and sodium concentrations where the Sig value < 0.05 in the r correlation.

DISCUSSION

Renal failure patients with CAPD therapy showed most CAPD patients had low albumin concentrations. This study's results align with Purwanto et al., (16) which examined the albumin profile of CAPD patients at RSUP. Dr. Sardjito Yogyakarta stated that most CAPD patients were more in hypoalbuminemia conditions, as much as 80.7%. Decreased concentrations of albumin in the blood causing edema or disfigurement in the patient's body (10).

The results of the data analysis found a strong and unidirectional relationship between albumin concentrations and sodium concentrations in CAPD patients. The results of this study are in line with Chang et al., (8), which examined hyponatremia as a predictor of mortality in peritoneal dialysis (CAPD) patients.

In the study, one of the factors was that serum sodium concentrations were positively related to serum albumin in CAPD patients. The relationship in this study is related to the age of CAPD patients and the complications of peritonitis that cause hypoalbuminemia to cause overhydration, causing hyponatremia in CAPD patients who were examined at the Clinical Pathology Laboratory of PHC Hospital Surabaya. The glomerular filtration rate decreases as you age because the kidneys' renal mass decreases as a result of losing numerous nephrons. After reaching adulthood, body tissues' cells start to deteriorate.

In the elderly, there is a decrease in the number of nephrons by 5-7% every decade starting at the age of 25 (17). Patients receiving peritoneal dialysis (CAPD) are at an elevated risk of morbidity and death, which is highly predicted by serum albumin concentrations. The amount of albumin in the body and serum albumin concentration is determined by several factors, including liver albumin synthesis (which is influenced by diet), protein intake, protein catabolism, and

extravascular distribution of albumin. In addition to these factors (18). Because the protein is lost into the peritoneal effluent in individuals with CAPD, the serum albumin concentrations are sensitive to adverse effects. Serum albumin concentrations were significantly associated with serum potassium concentrations, and patients with hypokalemia had lower serum albumin concentrations than patients without hypokalemia (19).

The concentration of potassium is approximately 30 times higher in the intracellular space than it is in the extracellular space. Numerous factors affect how potassium is distributed between the extracellular and intracellular fluid compartments. The Na-K ATPase transporter's active transport in the opposite direction causes the potassium to go through the cellular membrane following passive diffusion from the intracellular to the extracellular compartment (Na-K pump). According to our examination, albumin concentration and serum potassium concentration in people with peritonitis were statistically correlated.

Even though CAPD is simple to implement, it can result in a number of problems that, if unchecked, can be fatal.

Peritonitis is a common side effect. Inflammation (peritonitis) and hypoalbuminemia are linked to quantifiable excess body water (overhydration) in CAPD patients (20).

CONCLUSIONS

A relationship between albumin concentrations and sodium and potassium concentrations in CAPD patients in the three age-difference groups, which give values below the average, can be inferred from the research findings and the Spearman correlation test. According to our research, people with hypokalemia have lower serum albumin concentrations than those without the condition.

AUTHOR CONTRIBUTIONS

Dian Anggraini: conceptualization, methodology, investigation, writing-reviewing, editing, software, data curation, and writing-editing, methodology. Edy Haryanto: Validation. Syamsul Arifin: Validation. Ayu Puspitasari: Editing – reviewing.

CONFLICT OF INTEREST

There are no conflicts of interest.

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