Comparison of cardiovascular risk factors in maintenance hemodialysis patients based on phase angle of bioimpedance analysis

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Abstract. Mortality and morbidity rate, especially from cardiovascular disease in hemodialysis patients in Indonesia is still quite high. One of indicator to assess the predictive value of mortality is the phase angle (PhA) of bioimpedance analysis (BIA) scan examination. Determining the comparison of BMI and laboratory data as cardiovascular risk factors in hemodialysis patients based on PhA A cross-sectional analytical study was done on 155 outpatients in Rasyida Renal Hospital, Medan in 2016. Patients were two groups, namely PhA<4 group and ≥ 4 group. The comparison of BMI and laboratory data based on PhA were by analyzing the independent T-test. A P-value <0.05 was considered statistically significant. Most of the patients are male (56.7%), obese (39.4%), with age 40-59 years (56.1%). Based on PhA, 56.7% patients have PhA ≥4. There are differences in the profile of age (p: 0.01), BMI (p: 0.028) and hemoglobin (p: 0.00) between two groups, but not in the profile of albumin (p: 0.071), total cholesterol (p: 0.65), HDL (p: 0.06), LDL (p: 0.07), triglyceride (p: 0.87), calcium (p: 0.59) and phosphorus (p: 0.17). Based on PhA, the cardiovascular risk factors of hemodialysis patients were determined by age, BMI, and hemoglobin.

1. Introduction

The morbidity and mortality rate of patients with end-stage renal disease (ESRD) undergoing dialysis is still very high, approximately 15-20 percent per year, despite improvements in the management of cardiovascular disease, infection and dialysis therapy.[1] One of the principal causes of morbidity and mortality of ESRD patients in various countries is cardiovascular disease. There are various risk factors for cardiovascular disease such as BMI, albumin, lipid profile, hemoglobin, calcium, and phosphorus.[2]

The PhA value was proved to be a predictor of survival of HD patients.[3-5] PhA is one of the parameters that can be from BIA. Low phases occur in the presence of an increase in cell death and cell membrane damage or decreased cell integrity, whereas high PhA values indicate a good number of cell membranes and body cell mass (BCM).[6] Research proves that PhA can be as a prognostic indicator of chronic HD patients, where patients with low PhA values have a higher relative risk (RR) mortality compared with patients with normal to high PhA values.[3,4]

Based on the above description it was concluded that PhA could predict mortality in HD patients either because of cardiovascular disease as well as other causes, whereas cardiovascular disease is influenced by various factors. So it is assumed that there is an independent relationship between various factors that affect cardiovascular disease with the value of PhA. Therefore, this study was
conducted with the aim of knowing the relationship between BMI and laboratory data as cardiovascular disease risk factors with PhA as an indicator of mortality.

2. Methods
This study was analytic with a cross-sectional design, involving 155 patients with total sampling method and performed in June 2016 at Rasyida Renal Hospital, Medan. The inclusion criteria of this study were ≥18 years old, undergoing HD 2-3 times a week for ≥ 3 months and willing to undergo laboratory examination and BIA scan.

All patients performed hemoglobin, URR, and BIA scan. Then the patient is divided into two based on the value of PhA; PhA<4 and PhA ≥4. The average comparison of each variable was by using independent T-test. It is significant if p <0.05.

3. Results
From the results of research, data is obtained in the form of tables as below.

| Table 1. Characteristics of hemodialysis patients at rasyida renal hospital. |
|-----------------------------|-----------------------------|
| Variable                    | n   | %  |
| Gender:                     |     |    |
| - Men                       | 88  | 56.7|
| - Women                     | 67  | 43.3|
| Age                         |     |    |
| - 20 – 39 years             | 18  | 11.6|
| - 40 – 59 years             | 87  | 56.1|
| - ≥ 60 years                | 50  | 32.3|
| Body Mass Index             |     |    |
| - < 18.5 (under weight)     | 5   | 3.2 |
| - 18.5 – 22.9 (normal weight)| 48  | 31.0|
| - 23 – 24.9 (over weight)   | 41  | 26.4|
| - ≥ 25 (obese)              | 61  | 39.4|
| Group                       |     |    |
| - Phase Angle <4            | 67  | 43.3|
| - Phase Angle ≥4            | 88  | 56.7|

From the table above shows that most hemodialysis patients in Rasyida Renal Hospital are male (56.7%) with age 40-59 years (56.1%) and obesity (39.4%). Based on PhA value, most of the patients have PhA value ≥4 (56.7%).

| Table 2. The average comparison of various risk factors for cardiovascular disease based on the value of PhA. |
|-----------------------------------------------|-----------------------------|
| Categories                                 | <4 | ≥4 | P     |
| Mean | SD  | Mean | SD  |     |
| Age  | 57.21 | 11.064 | 51.02 | 11.473 | 0.01* |
| BMI  | 23.728 | 3.655 | 25.128 | 4.063 | 0.04* |
| Hemoglobin      | 9.805 | 1.058 | 10.494 | 1.155 | 0.00* |
| Albumin         | 3.384 | 0.377 | 3.509 | 0.287 | 0.07 |
| Fat Mass        | 25.675 | 9.07 | 28.424 | 8.27 | 0.02* |
| Total Cholesterol| 178.67 | 46.707 | 174.92 | 43.707 | 0.65 |
| HDL             | 44.94 | 10.271 | 48.72 | 10.905 | 0.06 |
| LDL             | 104.48 | 27.323 | 102.63 | 26.280 | 0.71 |
| Triglycerides   | 98.30 | 31.048 | 97.38 | 31.420 | 0.87 |
| Calcium         | 8.5412 | 0.431 | 8.5411 | 0.493 | 0.59 |
| Phosphor        | 4.702 | 0.887 | 4.797 | 0.995 | 0.17 |

* indicates significant at p <0.05.
The table shows that in groups with PhA ≥4; who associated with lower mortality, BMI (p = 0.04), fat mass (p = 0.02), and hemoglobin (p = 0.00) were better than those in the PhA<4 group. Although the mean of albumin (p = 0.07) and HDL (p = 0.06) was better. There was no statistically significant difference between the two groups. While total cholesterol, LDL, triglycerides, calcium, and phosphorus did not show the difference of mean in both groups.

4. Discussion

Research shows that PhA is inversely proportional to age and is directly proportional to BMI [7]. The same results also indicated by this study that patients who had PhA≥4 tended to be younger than patients with PhA<4 (p = 0.01). It may be because younger patients have fewer comorbidities so that their health conditions are better than those of later age.

BMI in patients who had PhA ≥4 was higher than patients with PhA<4 (p = 0.04). Correlation with BMI is not surprising because PhA is directly related to cell membranes (number and function). A person with a high BMI has more cells (fat or muscle cells) because of that the PhA value is higher. The greater the BMI of the HD patient; which associated with better food intake, the better the life expectancy.[7]

PhA is influenced by the mass of body cell which is the largest body compound where the metabolic process occurs. Fat mass is a level to assess the amount of fatty tissue in the body (in percent).[8] Through BIA Scan examination, the difference of fat mass between the two groups (p = 0.02). Whether high-fat mass in patients with PhA≥4 associated with large BMI and large body mass of cells, further research is needed.

The results presented that there was a difference of hemoglobin level between the two groups (p = 0.00). Many factors play a role in patient hemoglobin levels, including nutritious food intake.[9] The amount of nutritious food intake can be assessed from a large BMI. Patients with PhA ≥4 is better BMI.

The low value of PhA in chronic HD patients is caused by chronic inflammatory processes and malnutrition due to uremia.[10] It was proven with the results of this study that the albumin value in the PhA ≥4 group was greater than the group of patients with PhA<4, although not statistically significant (p = 0.071). It may be due to other factors affecting the albumin and PhA of patients such as inflammation. So needed a further research about the relationship of these factors.

Although the total cholesterol, LDL, HDL and triglyceride profiles in the PhA ≥4 group were better than the group of patients with PhA<4, statistically this was not proven to be significant (p> 0.05). It may be due to other factors affecting the patient's cholesterol such as the type of food consumed or the history of using statins and fibrates. So that required further research to analyze the relationship of these factors.

5. Conclusion

Indicators of mortality due to cardiovascular disease assessed with phase angle in hemodialysis patients are determined by age, BMI, and hemoglobin. Lipid profiles that play a significant role in mortality of cardiovascular disease in the general population seem not affect on hemodialysis patients.

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