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Blood pressure difference between regular hemodialysis and hemodialysis with hemoperfusion at Haji Adam Malik Hospital, Medan-Indonesia

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ABSTRACT

Background: The differences of Hemodialysis and Hemoperfusion's combination can increase of Uremic Toxin clearance, average creatinine clearance, and Angiotensin elimination optimally. The hemodialysis and hemoperfusion's combination also can decrease blood pressure and reduce the use of Anti Hypertension drugs so that the number of cardiac events in CKD patients may decrease. The use of ABPM is chosen because this is the best method of automatic blood pressure which has the most accurate blood pressure measuring periodically.
Objective: This study aims to determine the difference of regular Hemodialysis and Hemodialysis with Hemoperfusion on blood pressure measured by using ABPM in Medan, North of Sumatra.
Methods: This study was a pre-experimental study which conducted since December 2013-March 2014 to the 20 regular hemodialysis patients. The measurement included anamnesis, height, weight, systolic and diastolic blood pressure among patients with regular hemodialysis and hemodialysis with hemoperfusion.
Results: The study found that about 3 of 20 subjects were out of the study. There was no significant difference found in systolic and diastolic blood pressure between regular hemodialysis and hemoperfusion group (P = 0.807 and 0.906, respectively) based on the T-paired test and Wilcoxon test.
Conclusion: There was no significant difference between blood pressure measured using ABPM on the combination of hemodialysis and hemoperfusion compared with regular hemodialysis

Keywords: Blood pressure, hemodialysis, hemoperfusion
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INTRODUCTION

The morbidity and mortality rates of patients with the end-stage chronic kidney disease undergoing regular hemodialysis are still high ranging from 15-20% per year, despite improvements in the management of cardiovascular disease, infections, and dialysis therapy modalities.[1]

The incidence of some conditions such as malnutrition, body fluid status disorders, insulin resistance, pathological changes in the peripheral nervous system, bone mineral impairment, left ventricular hypertrophy, refractory hypertension, chronic systemic inflammation, and rapid decline in residual renal function among patients with regular hemodialysis is still quite high.[2-4] Some previous studies have demonstrated that the occurrence of medium-term and long-term complications of uremic toxin was closely related to the small, medium, and large molecule uremic toxin clearance during hemodialysis. The relationship of uremic toxin components and its biological effect is well known, whereas the hemodialysis therapy that aims to remove uremic toxin has been developed to improve quality of life and to reduce the hemodialysis patient's mortality. Clinical application of the various models of extracorporeal hemodialysis technology suggest the molecular uremic toxin clearance effectiveness with medium and big molecular weight as follows: hemodialysis (HD) + hemoperfusion (HP) > HP > bio-artificial kidney > hemodiafiltration (HDF) > hemofiltration (HF) > HD.[5]

In China and other developing countries, due to the low economic rate, hemodialysis commonly uses low-flux dialyzers where this method may not clean uremic toxins molecule with medium and large molecular weight as well as toxins that are bound to the proteins during hemodialysis. These results in long-term complications due to the accumulation of medium and large molecular weight uremic toxins will lead to decreased quality of life and increased the mortality of hemodialysis patients.[6]

The combination of hemodialysis and hemoperfusion (HD/HP) has been widely implemented in the hemodialysis centers of China and included in the health insurance program.[7] The HD/HP

combination can increase the average of creatinine clearance, veining, and lower blood pressure as well as reduce anti-hypertension drugs usage so that the number of cardiovascular events in CKD patients may decrease.[7,8] The ABPM has been selected for an automated blood pressure measurement method due to the best accuracy in measuring blood pressure on a regular basis.[7] Accordingly, this study aims to determine the blood pressure difference between regular hemodialysis and hemodialysis with hemoperfusion at Haji Adam Malik Hospital, Medan-Indonesia

METHODS

It was a pre-experimental study with pre-test and post-test design. This study was conducted at Hemodialysis Unit of Haji Adam Malik Hospital, Medan (Kidney and Hypertension of Raysida Clinic). The samples were collected at the beginning of December 2013. The samples of this study were CKD patients who undergo hemodialysis combined with hemoperfusion based on inclusion and exclusion criteria as much as 20 respondents. The inclusion criteria for this study included: 1. Regular hemodialysis patients (≥ 3 months); 2. age ≥ 17 years; 3. willing to participate in the study; and 4. with or without anti-hypertensive drugs. While the exclusion criteria included: 1. Patients who were not willing to be examined; or 2. Patients with HD irregularly. The primary data were obtained in this study by using ABPM.

RESULTS

The Characteristics of Study Subjects

This study found that male gender was 16 patients (80%), followed by females about 4 patients (20%). According to the age group, the mean value of the 29-79 years age interval was 47.40 ± 11.58 years. The average duration of hemodialysis was 2.78 ± 2.24 years where the length of hemodialysis less than or equal to 5 years as well as over 5 years about 17 and 3 patients respectively. In the course of the study, 3 of 20 subjects observed were out of study (2 subjects refused to do APBM, and one subject died). With ABPM measurement, the study of hemodialysis patients group found that the systolic and diastolic blood pressure was 164.11 ± 20.56 mmHg and 103 mmHg (87-110) respectively. However, in the hemodialysis and hemoperfusion group, the systolic and diastolic blood pressure was 163.11 ± 22.74 mmHg and 102.66 ± 9.16 mmHg respectively (Table 1).

The Differences Combination of Hemodialysis (HD)/ Hemoperfusion (HP) against ABPM

This study was conducted by measuring systolic and diastolic blood pressure using ABPM. The Paired T-Test analysis was performed if the data on both groups normally distributed, otherwise Wilcoxon test will be used if the data were not normally distributed.

From 17 subjects observed, the systolic blood pressure in the hemodialysis patients or hemodialysis and hemoperfusion patients were 163.88 ± 20.6 mmHg and 162.82 ± 22.73 mmHg respectively. The Paired T-Test on the systolic blood pressure of HD and HD+HP obtained 0.807 of P-value (P > 0.05) so that it can be concluded that there was no statistically significant difference between in patients with hemodialysis using hemodialysis + hemoperfusion.

According to the diastolic blood pressure, the hemodialysis patients give result in 103 mmHg (87-170) followed by 102.58 ± 9.16 mmHg in the hemodialysis and hemoperfusion patients. The Wilcoxon test found that the P-value of diastolic blood pressure in HD and HD+HP patients were 0.906 (P > 0.05), where it indicated there was no statistically significant difference in diastolic blood pressure between HD and HD+DP patients.

Table 1. The basic characteristics of study subjects

Variable	Mean
Sex (n)	
– Male	16 (80%)
– Female	4 (20%)
Age (years)	47.40 ± 11.59
Height (cm)	164.35 ± 6.41
Weight (kg)	63.64 ± 10.53
The length of hemodialysis (years)	2.78 ± 2.24

Table 2. The blood pressure data

Blood Pressure	Mean
Systolic HD	163.88 ± 20.6
Systolic HD + HP	162.82 ± 22.73
Diastolic HD	103 (87-170)
Diastolic HD + HP	102.58 ± 9.16

DISCUSSION

Uremic toxins are known as the major causes of uremic symptoms, metabolic disorders, and uremic complications. In addition to urea nitrogen and creatinine, middle and large molecule substance, protein-bound small molecules, short-chain amino acids and cytokines are playing a pivotal role in the pathological process of the maintenance hemodialysis (MHD) patient complications.[9,10] Previous studies have demonstrated that medium and long-term complications of uremic toxins are associated with small, medium, and large molecular clearance rates of uremic toxins during hemodialysis.[7,9]

The relationship of uremic toxic components and their biological effects is well known, then the hemodialysis therapy that aims to dispose of uremic toxins has developed to improve the quality of life and reduce mortality of hemodialysis patients.[7] However, the hemodialysis alone is not adequate in the clearance of medium and large molecular uremic toxin. Therefore, they combined hemodialysis with hemoperfusion to obtain maximum

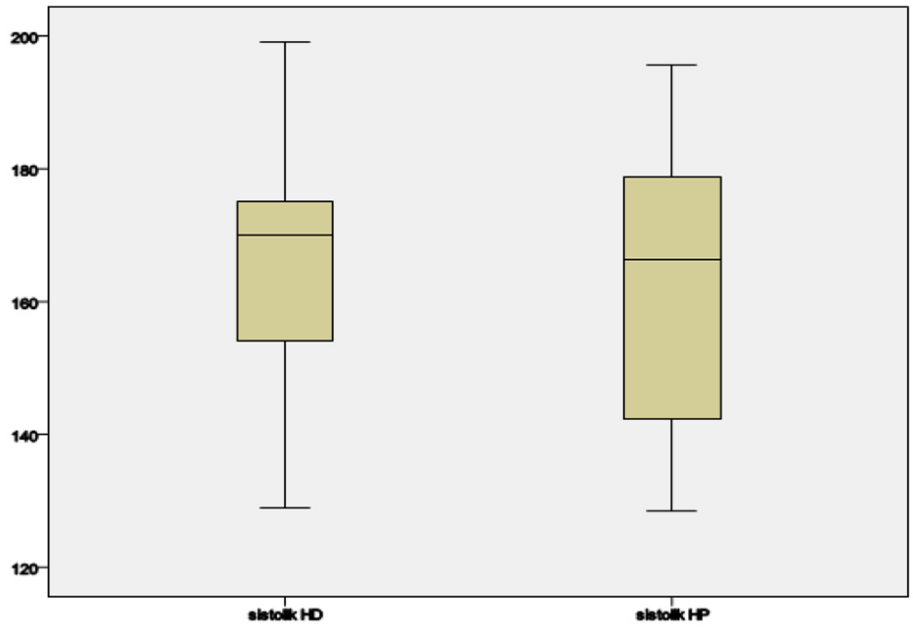

Figure 1. The Boxplot result of the HD and HD/HP systolic blood pressure

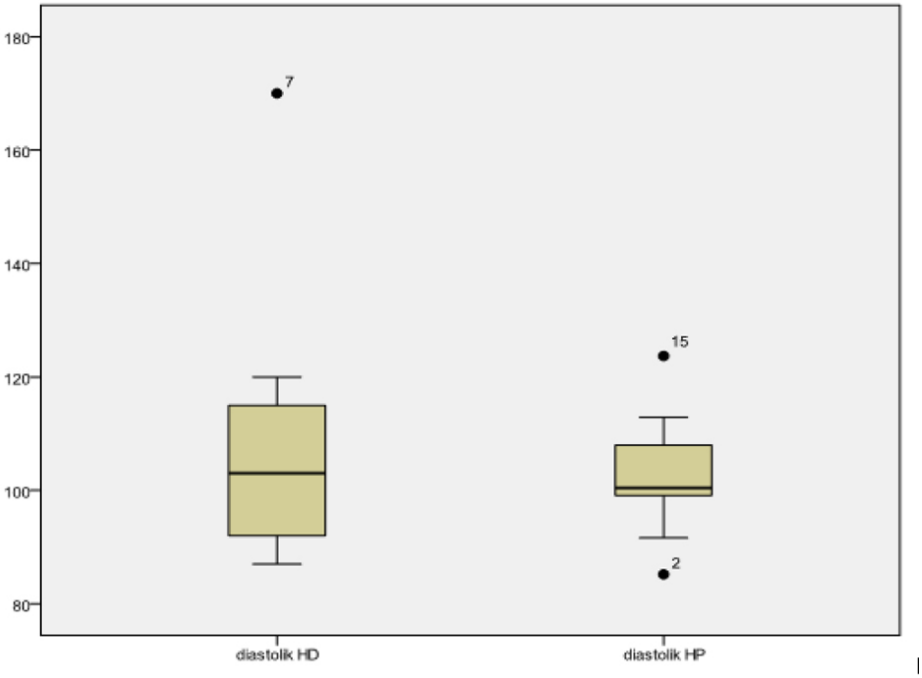

Figure 2. The Boxplot result of the HD and HD/HP diastolic blood pressure

Table 3. The Effect of Hemodialysis (HD)/ Hemoperfusion (HP) to the ABPM (Systolic and Diastolic)

Variable	N	HD	HD+HP	P
Systolic	17	163.82 ± 20.6	162.82 ± 22.72	0.807
Diastolic	17	103 (87-170)	102.58 ± 9.16	0.906

**Significant* (p<0,05)

uremic toxin clearance in China. So that, this study adopts hemoperfusion combination in the chronic kidney disease patients with regular hemodialysis for the maximum uremic toxin clearance to be achieved, and assessing its relationship with blood pressure through ABPM measurement.

Hemoperfusion is the passage of blood through a column packed with granules of Amberlite resin which act as absorbents.[11] In this procedure, physicochemical properties of an absorbent are used, while in hemodialysis there is a concentrational gradient between the blood and the solvent across the dialysis membrane. Hemoperfusion is when removing liposoluble substances which are bound to plasma proteins and have smaller molecular weight, as well as when the blood flow through the apparatus is greater.[12,13] Molecules of 300–5000 daltons are most efficiently eliminated. However, this procedure has its disadvantages, including side-effects such as thrombocytopenia and, therefore, it is reserved for most severe poisoning.[14]

In addition, the use of ABPM (Ambulatory Blood Pressure Monitoring) is an automatically measuring blood pressure method on regular basis for a certain period (24 hours) which has the best accuracy. The prevalence of hypertension is high in patients with chronic kidney disease (CKD) and increases with CKD stage from 79% in CKD stage I to 95% in CKD stage IV and V. In patients with CKD, the blood pressure (BP) reduction is not only important to prevent CV events but also to prevent the kidney function deterioration.

This study is trying to figure out the difference of systolic and diastolic blood pressure in CKD patients who had hemodialysis performed more than 3 months before and after hemoperfusion. The parameters assessed including systolic and diastolic blood pressure before and after hemoperfusion and to determine the relationship of each parameters.

Based on the ABPM measurement on 17 patients, the systolic and diastolic blood pressure of hemodialysis patients were 164.11 ± 20.56 mmHg and 103 (87-170) mmHg, while in the hemodialysis and hemoperfusion patients about

163.11 ± 22.74 mmHg and 102.66 ± 9.16 mmHg. In addition, the Paired T-Test on systolic blood pressure of HD and HD+HP patients suggested there was no statistically significant difference between hemodialysis patients with the hemodialysis + hemoperfusion patients (P = 0.807; P > 0.05). This result also similar in the diastolic blood pressure by using Wilcoxon test where there was no statistically significant difference in the hemodialysis patients with hemodialysis + hemoperfusion patients (P = 0.906; P > 0.05).

Those results cannot be compared with other studies due to no one has ever examined the combination of HD/HP particularly according to the systolic and diastolic blood pressure parameters with ABPM. However, one study conducted by Chen and colleagues on 100 patients with maintenance hemodialysis (MHD) found that the mean systolic blood pressure at the baseline HD and HD/HP combination were 155.1 ± 49.2 mmHg and 153.6 ± 45.7 mmHg, respectively (P = 0.874; P > 0.05).[7] The results suggested that there was no statistically significant difference between HD with HD/HP combination patients in the systolic blood pressure after 2 years of study.[7]

In addition to the systolic blood pressure, Chen SJ et.al (2011) also found that the mean diastolic blood pressure at the baseline HD and HD/HP combination were 87.1 ± 29.1 mmHg and 89.7 ± 27.1 mmHg, respectively (P = 0.644; P > 0.05). So that, it can be concluded that there was no statistically significant difference of diastolic blood pressure between HD with HD/HP combination patients in the early of study.[7] Nevertheless, after 2 years of study, the mean diastolic blood pressure became 90.6 ± 32.4 mmHg and 71.4 ± 15.6 mmHg either on HD and HD/HP combination patients (P = 0.001; P < 0.05). These results indicated that there was a statistically significant difference in the diastolic blood pressure between HD with HD/HP combination patients after 2 years of study.[7]

By comparing the results of this study with the previous study, the significant differences was found due to the length of study conducted. In addition, blood pressure measurements can be performed more accurately by using ABPM. The combination of HD/HP is a method which quite good on regular hemodialysis patients, especially for the hypertensive patients. This is due to hemoperfusion can eliminate angiotensin theoretically where lead to lowering blood pressure and reduce the amount of the anti-hypertensive drugs usage, so that the cardiac vascular events in CKD patients decrease.[8] This assumption also support by the fact that neutral resin as the adsorbents for the HA130 HP apparatus in the hemoperfusion could selectively adsorb those middle and large molecule uremic toxins (such as parathyroid hormone, β_2-MG, leptin, renin and angiotensin, cytokines, etc.) and protein-bound toxins (such as homocysteine, indole sulfate, spermine, cresol, etc.).[15,16]

The lack of this study is a small sample numbers provided and no adjustment for the characteristic of study subjects, so that further study on a larger scale in assessing the effectiveness of HD / HP combination to the ABPM is needed.

CONCLUSION

In summary, it can be concluded that there is no statistically significant difference between HD/HP combinations in the blood pressure measurement using ABPM on HD regular patients.

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