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The Relation of Dialysis Time with Ureum Reduction Ratio, Hemodynamics and Fatigue in Hemodialysis Patients at Wonosari Hospital

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Abstract

Background: Dialysis time is one component that affects the adequacy of hemodialysis (HD). The adequacy of HD is measured by the formulation of Ureum Reduction Ratio (URR). During HD there is a decrease in intravascular volume and electrolyte changes that can affect hemodynamics. HD therapy also makes patients feel fatigue.

Objective: This study was conducted to determine the relation between dialysis time and URR, hemodynamics and fatigue in HD patients in Wonosari Hospital..

Methods: This study used an analytic observational design with a cross sectional approach, recruited 52 respondents by total sampling technique. Data collection tools using laboratory examinations, digital tensimeters, digital thermometers, stopwatches, pulse oxymetry and the Functional Assessment Chronic Illness Therapy (FACIT) questionnaire Fatigue scale. Univariate data analysis with frequency distribution and bivariate analysis with the Spearman test.

Results: The results of this study showed that there was no significant relation between dialysis time and URR ($p = 0.291$), there was a significant relation between dialysis time and respiratory frequency ($p = 0.020$), and there was a significant relation between dialysis time and fatigue ($p < 0.001$).

Conclusion: The longer dialysis time, the more it can affect the decrease in hemodynamic value, especially the breath frequency, and it can relieve fatigue.

Keyword: *Fatigue, Hemodialysis, Hemodynamics, URR*

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Introduction

Hemodialysis (HD) is a kidney replacement therapy that uses a special tool to remove uremic toxins and to regulate fluids due to decreasing glomerular filtration rate by taking over a decreasing kidney function using a dialyzer membrane with dialysis or filtration techniques, which can be done in acute or chronic condition (1). An effective way to analyze HD performance is evaluate its adequacy (2). Increasing dialysis adequacy can reduce the uremic complication that can cause problems in the body's organs (3). HD adequacy can be measured by the laboratory values formulated as urea reduction ratio (URR) and dialyzed blood volume per unit time, known as Kt/V (4). Dialysis time is one of the components in prescribing HD that also affects adequacy (5). Research by El-Sheikh and El-Ghazaly stated that an increase in dialysis time by 30 minutes has a significant effect on the clearance value of the solute (6). According to the Indonesian Renal Registry, 41% of HD actions in Indonesia are done in 3 to 4 hours (7). The Hemodialisys Consensus published by Pernefri stated that the standard time for dialysis is 5 hours per session and the frequency was 2 times per week (1). HD procedures that are routinely done often cause patients to feel tired or fatigue (8). The duration of dialysis time causes reduced physical activity during the treatment procedure which is related to fatigue (9). According to Orasan et al. better removal of urea will reduce the fatigue level during or after HD (10). Fatigue is caused by dialysis, and dialysis also relieves fatigue due to accumulated toxic substances in patient (11). A rapid reduction in intravascular volume along with electrolyte changes occurs during HD, this interferes the heart's performance and peripheral blood vessels so the activation of various compensatory mechanisms to maintain tissue perfusion including hemodynamic changes (12). Hemodynamic instability can lead to intradialytic hypotension (IDH) and reducing HD quality due to insufficient filtration targets and / or early discontinuation of therapy (13). A preliminary study showed the total HD patients who routinely use Biolight machine in the HD unit at Wonosari Hospital were 57 people. Medical record data showed the variation value in the HD time duration was 4 to 5 hours. It was found that only 4 patients had adequate URR value, ≥80%. Instability hemodynamic is also found in 5 randomly picked patients, 100% experienced changes in Blood pressure, pulse rate, and respiratory rate, and 4 of them or 80% stated they were very tired. Based on the phenomenon, it is necessary to conduct a research to determine the relation between dialysis time and urea reduction ratio, hemodynamic, and fatigue in hemo dialysis patients at Wonosari Hospital

Method

This research used an analytic observational design with cross sectional approach. This study was conducted at the hemodyalisis unit at Wonosari Hospital, Gunungkidul Regency, Yogyakarta Special Region from December 2019 to January 2020. This research was declared ethical by the KEPK (Research Ethics Committee) Wonosari Hospital numbered 070/3499/2019. Total sampling technique was used based on the inclusion and exclusion criteria. There were 57 people in total. URR data was collected by taking pre HD and post HD blood samples with quick blood (QB) set at 100 ml / minute. Hemodynamic data collection consisted of respiratory rate, oxygen saturation, MAP, pulse rate, and body temperature were done after dialysis process was completed but the vascular access needle was not removed yet.

Fatigue data was collected by filling in the Functional Assessment Chronic Illness Therapy (FACIT) questionnaire by respondents after finishing

HD and after the vascular access needle was removed. The validity and reliability of the Indonesian version of the FACIT Fatigue questionnaire has been conducted by Sihombing et al. with the value of r pearson correlation > 0.279 which indicated that all question items were valid, and the cronbach r alpha value = 0.646 which indicated that the questionnaire instrument was reliable (14). Univariate data analysis of frequency distribution was done on respondent's characteristic data, dialysis time variable, URR variable, hemodynamic variable, and fatigue variable. The univariate data normality test was done using the Kolmogorof-Smirnov test.

The results of the normality test showed that the data distribution was not normal (p value <0.05) so that in the bivariate analysis it was decided to use the Spearman test.

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Results

Respondent's characteristic

Table 4.1 respondent's characteristic based on age, HD treatment periode, gender, and etiology

Respondent's characteristic	Median	Min	Max
Age	54	21	71
HD treatment period	4	1	8
		n	%
Gender			
Male		44	77,2
Female		13	22,8
Etiology			
Hypertensive kidney disease		37	64,9
Uric acid nephropathy		3	5,3
Diabetic nephropathy		15	26,3
Polycystic kidney		2	3,5

Table 4.1. Showed that the youngest respondent who underwent HD was 21 years old and the oldest respondent whounderwent HD was 71 years old. The longest period of respondent who went through HD was 8 years. 77.2% of the respondents were male and 22.8% were female. The disease that caused the most respondents to undergo HD was hypertensive kidney disease with the percentage was 64.9%.

Table 4.2. respondent's characteristic based on dialysis time, URR, hemodynamic status, and fatigue

	Median	Min	Max
Dialysis time	4,5	4,0	5,0
URR	73	47	87
Fatigue	32	20	49
Hemodynamic Status Respiratory rate	20	17	28
Oxygen saturation	99	96	99
Body temperature	37	35,1	37,6
	Mean	SD	
MAP	98,47	13,608	
Pulse rate	76,61	10,021	

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Table 4.2. Showed that the lowest dialysis time experienced by the respondent was 4.0 hours and the highest dialysis time experienced by the respondent was 5.0 hours with the aerage value was 4.5 hours. This showed that not all of them met the dialysis time standard according to the Pernefri Hemodialysis Consensus, which is 5 hours. The lowest URR value of the respondent was 47% and the highest URR value was 87% with the average value was 73%. This showed that not all of them met the URR standard, which is 80%. The lowest respondent's respiratory rate was 17 times per minute and the highest respondent's respiratory rate was 28 times per minute with the average value was 20 times per minute. This showed that an abnormal value was still found, which was 28 times per minute. The normal respiratory rate in adults is 12 to 20 beats per minute. The lowest value of oxygen saturation in respondents was 96% and the highest value of oxygen saturation in respondents was 99% with the average value was 99%. This indicated that the saturation value was in the normal range. Table 4.2 showed that the mean value of the respondents' MAP was 98.47 mmHg, it could be concluded that the average MAP was still within normal limits, which was 70 to 105 mmHg. The average value of the respondent's pulse frequency was 76.61 times per minute, indicating that the average pulse frequency was still within the normal range, which is 60 to 100 beats per minute. The lowest value of the respondent's body temperature was 35.1 ° C and the highest value of the respondent's body temperature was 37.6 ° C with average value was 37 ° C, this showed that abnormal temperature values were still found, which were 35.1 ° C and 37.6 ° C. The normal body temperature for adults is 36.5 ° C to 37.5 ° C. The lowest fatigue score was 20 and the highest fatigue score was 49 with average score was 32. Fatigue score which is of more than 30 indicates that the patient has mild fatigue, while less than 30 indicates that the patient is experiencing severe fatigue.

The Correlation between dialysis time with urea reduction ratio, hemodynamic and fatigue in hemodialysis patients at Wonosari Hospital.

Table 4.3. The Correlation between dialysis time with urea reduction ratio, hemodynamic, and fatigue in hemodialysis patients at Wonosari Hospital

		Dialysis Time	
		Correlation coefficient	P value
URR		0,142	0,291
Hemodynamic	Respiratory rate	**-0,308**	**0,020**
	Oxygen saturation	0,197	0,143
	MAP	-0,065	0,629
	Pulse Rate	-0,036	0,793
	Body temperature	0,130	0,335
Fatigue		**0,630**	**0,001**

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The correlation test between dialysis time and URR showed a p value of 0.291 (p value> 0.05), indicating that there was no relationship between dialysis time and the urea reduction ratio. The relationship between dialysis time and hemodynamics obtained the p value of oxygen saturation 0.143, MAP 0.629, pulse rate 0.793, body temperature 0.335 (p value> 0.05) and respiratory rate 0.020 (p value <0.05) which meant there was a correlation between dialysis time with hemodynamics (respiratory rate). The correlation coefficient was -0.308 which meant that the strength of the relationship was weak (0.2- <0.4) with a negative correlation direction, which meant that the longer the dialysis time, the lower the respiratory rate. The correlation test between dialysis time and fatigue obtained a p value of 0.001 (p value <0.05), which meant that there was a correlation between dialysis time and fatigue. The strength level of the correlation was 0.630 which meant strong (0.6- <0.8) with a positive correlation direction which meant that the longer the dialysis time, the higher the fatigue score.

Discussion

Respondent Characteristics

This study showed the youngest respondent was 21 years old and the oldest respondent was 71 years old with the average age was 54 years old. In line with the study by Wahyuni, Miro and Kurniawan , respondents at the HD installation Dr. M. Djamil Padang 74.1% were in the age range of 45 to 60 years old (15). This illustrates that the elderly are the most vulnerable to CKD. When people get older, the decreased kidney function is normal to happen. However, due to several risk factors, the decrease in kidney function becomes progressive (16).

The youngest age of respondents was 21 years old. It illustrates that CKD does not only occur in adult but also in teenager. According to 2013 Basic Health Research data, the rates of hypertension and pre-hypertension in adult aged 15 to 18 years old in Indonesia are quite high, 51.4% and 48.3% respectively (17).

This study showed that the 77.2% of respondents were male and 22.8% were female. In line with the research of Adhiatma, Wahab, and Widyantara , respondents in the HD unit of Tugurejo Hospital Semarang 62.1% were male and 37.9% were female (18). This shows that men have higher risk of developing CKD than women. High activity and unhealthy diet are the trigger factors for hypertension in men (19). This is consistent with this study in which hypertensive kidney disease was the main etiology of respondents who underwent HD.

This study found that the cause of most respondents undergoing HD was hypertensive kidney disease at 64.9%. this is in line with the research of Adhiatma, Wahab and Widyantara there was a significant relationship (p value 0.023) between hypertension and the incidence of CKD so that respondents had to undergo HD at Tugurejo Hospital Semarang (18). Hypertension causes atherosclerosis (80%) resulting in narrowing of blood flow to the kidneys and damage the kidney tissue (20).

This study showed that respondents' periods of undergoing HD were between 1 and 8 years with the average value was 4 years. Dewi and Anita's research at PKU Muhammadiyah Yogyakarta Hospital also revealed that 68.3% of respondents had undergone HD more than 2 years (21). The high number of years of undergoing HD shows that patients are able to survive even though they are in a malfunctioning kidney condition and experience health problems due to kidney damage they have experienced (22).

The dialysis time duration that the respondents took in this study varied between 4 to 5 hours with a mean value of 4.5 hours. In line with the research of Dewantari *et al.* at Abdul Moeloek Hospital in Bandar Lampung that the most dialysis time was 4.5 hours at 58.1% (23). This illustrates that there are still many patients whose

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dialysis time is not optimal according to the Hemodialysis Consensus standard. Longer dialysis time can contribute to better clinical conditions and survival (24).

This study showed that the lowest URR value of the respondents was 47% and the highest URR value of the respondents was 87% with the average value was 73%. Almost the same as the research by Armezya, Nasrul and Bahar at Dr. M. Djamil Padang, the average URR value was 68.80% with the lowest value was 31.58% and the highest value was 96.57% (25). It is assumed that there are still many HD therapies that do not meet the adequate standards according to the Hemodialysis Consensus issued by Pernefri, 80%. Adequacy with low scores is strongly associated with increased morbidity (26).

Hemodynamic measurements in this study consisted of respiratory rate with an average value was 20 times per minute, oxygen saturation with an average value was 99%, MAP with an average value was 98.47 mmHg, pulse rate with an average value was 76.61 times per minute, and body temperature with an average was 37° C. Almost the same as the study by Sucipto, Pranatha and Rahil at Panembahan Senopati Bantul Hospital which stated that after the HD hemodynamic was done, it remained within normal limits, indicated by an average pulse frequency value was 86 times per minute, respiratory rate was 21 times per minute, average oxygen saturation was 96%, body temperature average was 36.2° C (27). It can be assumed that HD can maintain hemodynamics in CKD patients. The high ureum in CKD patients causes hemodynamic stress that can accelerate the aging of the arteries and the heart, so that it can affect the microcirculation of other organs (28,29).

The fatigue score in this study was measured using the FACIT fatigue scale with an average value was 32. Almost the same as the research of Sihombing et al. in routine HD patients at the Yogyakarta Academic Hospital resulted in a fatigue score was 45.16 so that it can be interpreted that respondents experienced a mild level of fatigue (14). Mild fatigue illustrates that patients can maintain and regulate their physical and psychological conditions during therapy. Psychological disorders in the form of feelings of helplessness, depression, and stress are factors that cause fatigue that is often found in chronic disease patients who undergo routine treatment such as HD (30).

The relationship between dialysis time and urea reduction ratio, hemodynamic and fatigue in HD patients at Wonosari Hospital

The results showed no relationship between dialysis time and URR (p value 0.291), although controls were performed to maintain homogeneity of the respondents such as the use of a new dializer with the same membrane area of 1.8 m2, fistula arteriovenous vascular access (AV), mature vascularity. and a blood flow rate was 200 ml per minute. On the other hand, the research results of Abdelwahab and Shigidi stated that increasing dialysis time can also increase the URR value (p value <0.05) (31). It is assumed that the prescribing of HD as a whole can affect the decrease in the urea values. Inadequate prescription of HD, such as the use of inappropriate filters, low blood pump speed, and short duration of HD are the causes of insufficient dialysis adequacy (3).

Dialysis time was associated with hemodynamic indicators. The results statically showed that there is a significant relationship between dialysis time and hemodynamics (respiratory rate) (p value = 0.020). Almost the same as the research by Maharsi and Hartono at Dr. Moewardi hospital stated that there were hemodynamic changes in patients who were undergoing HD therapy with indicators of MAP, pulse rate and respiratory rate (p value <0.05) (32). The research equation lied in the decreased respiratory rate after HD. It can be assumed that a longer dialysis time can reduce the respiratory rate.

CKD patients often show an increased respiratory frequency disorders due to fluid buildup in the lungs (33,34). Fluid buildup in the lungs or called pulmonary edema occurs when there is a movement of fluid from the blood to the alveoli due to excess fluid buildup in the body and hypoalbuminemia. Hypoalbuminemia is a characteristic of CKD which causes a decrease in plasma oncotic pressure, so that it encourages the movement of fluid from the pulmonary capillaries (35). Hemodialysis can reduce the uremic status, remove excess body fluids, maintain acid-base and electrolyte balance, but can also reduce pulmonary edema and obstruction in the small airways so that lung ventilation increases (36).

Based on the fatigue variable, it can be concluded that statistically there was a significant relationship between dialysis time and fatigue (p value <0.001). Longer

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Dialysis time is associated with a better dialysis adequacy

(6). Research by Wang et al. at the Tianjin Tertiary Hospital in China stated that the results of the mean score of FACIT fatigue scale was 39. It was interpreted that patients were experiencing mild fatigue related to dialysis adequacy (37). This illustrates that the optimal dialysis time according to the Pernefri Consensus which was 5 hours per session makes fatigue levels lighter, while shortening the dialysis time can increase the risk of experiencing heavier levels of fatigue.

Inadequate dialysis which results in high urea values can interfere the production of the hormone erythropoetin. This results in a decreased number of red blood cells or anemia. Anemia can interfere the distribution of nutrients and oxygen and can cause patients to experience fatigue (38). Fatigue in HD patients is often associated with poor quality of life style and is also a predictor of cardiosvascular disease (39, 40).

Conclusion

There were some characteristics of respondents in this study. The first characteristic was age. It ranged from 21 to 71 years old. The second characteristic was gender. There were more men respondents than women respondents in this study. Next, the disease that caused the most respondents to undergo HD was hypertensive kidney disease. Then, the longest period of people who were undergoing HD was 8 years. The average dialysis time was 4.5 hours.

A minimum URR value was 47% and the average value was 73% indicated that adequate adequacy had not been achieved. Then, Respiratory rate found was an abnormal value, which was 28 times per minute. Normal oxygen saturation with a value range from 96% to 99%. The average MAP within normal limits was 98.47 mmHg. The pulse frequency was still within the normal range, which was 76.61 beats per minute. The body temperature was still found with an abnormal temperature of 37.6 ° C. Finally, the score for fatigue was at least 20, which meant that there were still respondents who experience severe fatigue. There was no significant relationship between dialysis time and urea reduction ratio. There was a significant relationship between dialysis time and hemodynamics (respiratory rate), but there was no significant relationship between oxygen saturation, MAP, pulse frequency and body temperature. There was a significant relationship between dialysis time and fatigue in hemodialysis patients at Wonosari Hospital.

Recommendation

The researchers recommend the respondents for not only concern about the comfort factor subjectively by shortening the dialysis time but also have to be aware of the clinical impact. Recommendation for the health services is improving HD quality by optimizing prescribing, educating, and monitoring intra dialysis and patient fatigue. Furthermore, recommendations for the next researchers, they have to develop further research with a larger number of samples and expand research by linking vascular access distance to URR or hemodynamics with fatigue in HD patients.

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