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Associated factors of post-hemodialysis recovery time in kidney failure patients☆

Gusti Ayu Ary Antari[a,b,*], Lestari Sukmarini[a], Muhamad Adam[a]

[a] Faculty of Nursing, Universitas Indonesia, Depok, West Java, Indonesia
[b] Nursing Study Program, Faculty of Medicine, Udayana University, Bali, Indonesia

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Abstract
Objective: To identify the factors related to post-hemodialysis recovery time in kidney failure patients.
Method: This study used a descriptive correlation design with a cross-sectional method. The samples in the study were 185 hemodialysis patients at Sanglah Central Hospital, Denpasar, who were recruited through a consecutive sampling technique. Data were analyzed using multiple linear regressions.
Results: The results of the study showed that the mean recovery time was 578.41 ± 402.27 min. Post-hemodialysis recovery time was found to be significantly related to the hemodialysis schedule ($p = 0.029$), comorbid diseases ($p = 0.046$), the number of acute complications ($p = 0.001$), and depression ($p = 0.004$). The results of multivariate analysis showed that the number of acute complications during hemodialysis was the most dominant factor related to recovery time ($\beta = 0.747$).
Conclusion: Gender, upper-arm circumference, hemodialysis schedule, sodium dialysate concentration, intradialytic weight loss, comorbid diseases, and the number of acute complications were found to be significant correlated with post-hemodialysis recovery time.

Introduction

Patients with kidney failure, indicated by a decrease in glomerular filtration rate to less than 15 ml/min/1.73 m^2 require renal-function-replacement therapy, such as hemodialysis. This therapy plays an important role in ensuring patient survival.[1–4] The prevalence of end stage

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* Corresponding author.
E-mail address: ary10antari@gmail.com (G.A.A. Antari).

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renal disease (ESRD) in 32 countries increased by 48% between 2001 and 2014.[5] This significant increasing in ESRD also occurs in Indonesia, where it has doubled, from 66 patients per million people in 2013 to 134 patients per million people in 2014; this phenomenon is related to the increasing need for dialysis services. In Indonesia the prevalence of dialysis patients reached 130 patients per million people by 2014; 96.1% of patients use hemodialysis, and only 3.9% use peritoneal dialysis.[5]

During hemodialysis, the patient undergoes a series of excess fluid, electrolytes, nitrogen and metabolic products removal processes.[6] Consequently, the patient is susceptible to rapid hemodynamic changes, resulting in various acute side effects during hemodialysis. These side effects include nausea, cramps, fatigue, pruritus, intra-dialysis hypotension, and headache.[7–9] During hemodialysis, patients need to calculate their time for transportation and follow a series of activities in the hemodialysis unit, these situations can cause them feeling exhausted and could further affect their post-hemodialysis recovery.

The concept of post-hemodialysis recovery time was introduced by Lindsay et al.[10] who found that post-hemodialysis recovery time is an important indicator for patients' quality of life. According to Lindsay et al., post hemodialysis recovery time is the time needed by the patient to recover after undergoing hemodialysis. Patients with slow recovery times were reported to have a lower quality of life than patients with rapid recovery time. A cohort study by Rayner et al.[11] also supported this result; it found that patients with recovery times over 12 h had a 22% increased risk of hospitalization and a 47% higher risk of death, compared to patients with recovery times of 2–6 h.

Based on the research results, Lindsay et al.[10] and other researchers conducted a study which also aimed to analyze factors related to post-hemodialysis recovery time. However, the results of the study still remain debatable. Bossola et al.[7] found that only fatigue and depression were significantly associated with post-hemodialysis recovery time. While Smokovska et al.[12] discovered a strong correlation between intra dialysis weight gain (IDWG), albumin, urea, body mass index (BMI), protein catabolic rate, and hemoglobin with post-hemodialysis recovery time.

Existing studies have not been able to clearly illustrate differences in outcomes and clarify the pathogenesis of prolonged post-hemodialysis recovery times. In addition, studies about post-hemodialysis recovery time are still limited. Thus, it is necessary to conduct research in Indonesia on different patient characteristics. This study aimed to identify the associated factors of post-hemodialysis recovery time.

Method

This research used a descriptive correlational design with a cross-sectional approach. The study conducted from April to May 2017 in the hemodialysis ward of Sanglah Hospital, Denpasar, Indonesia. The Research samples were selected through a consecutive sampling. The patients' inclusion criteria in this study included kidney failure patients who have been assigned to regular, long-term hemodialysis twice per week, were aged $\geq$18 years, able to read and write, and in a compos mentis level of consciousness. The exclusion criteria included patients undergoing hemodialysis with a duration <5 h or >5 h and patients who, during the hemodialysis session, experienced a declined level of consciousness. Moreover, this study involved 185 patients with kidney failure undergoing hemodialysis.

The research instruments in this study were a questionnaire of respondent data, observation sheet, Beck Depression Inventory (BDI) II, and a post-hemodialysis recovery time questionnaire. BDI-II is a valid and reliable instrument in measuring depression in hemodialysis patients (Cronbach's alpha 0.86). Furthermore, the ethical approval for research was obtained from ethical review committee of the Faculty of Nursing, Universitas Indonesia and Sanglah Hospital, Denpasar, Bali. The research data consisted of univariate, bivariate, and multivariate analysis. A simple linear regression test, Rank Spearman or non-distributed data, and ANOVA were used in bivariate analysis, while the multiple linear regressions was taken into account for multivariate analysis.

Results

Respondents' characteristics

The number of acute side effects during hemodialysis is the number of unpleasant complaints experienced by the patient during hemodialysis, such as headache, intradialytic hypotension, intradialytic hypertension, nausea, etc. (Tables 1 and 2).

In this study, majority of the respondent was male (59.5%) with around a half of the respondent has a morning hemodialysis schedule (53.5%). Furthermore, most of the respondent has hypertension and PNC for ESRD comorbidities (70.3%).

Association of respondent characteristics with post-hemodialysis recovery time

In addition to the above findings, there were several other variables that did not have a significant association with post-hemodialysis recovery time, including age ($p = 0.467$), upper-arm circumference ($p = 0.193$), gender ($p = 0.07$), length of hemodialysis ($p = 0.563$), IDWL ($rs = 0.114$; $p = 0.123$), Kt/V ($p = 0.504$), sodium dialysate concentration ($p = 0.225$), and ultrafiltration rate ($p = 0.309$) (Tables 3–6).

Prediction model of post-hemodialysis recovery time

The results of the multivariate analysis found that there is a significant association ($r = 0.781$, $p = 0.0001$) between seven independent variables and post-hemodialysis recovery time. The seven variables included in the multivariate model are gender, upper-arm circumference, hemodialysis schedule, sodium dialysate concentration, IDWL, number of acute side effects during hemodialysis, and ESRD comorbidities. The value of R^2 (0.61) indicates that the seven independent variables can explain 61% the variation of post-hemodialysis

Table 1 Age, upper-arm circumference, length of hemodialysis, IDWL, number of acute side effects during hemodialysis, depression, and post-hemodialysis recovery time.

Variable	Mean ± SD	95% CI
Age	51.17 ± 12.87	49.30; 53.03
Upper-arm circumference	26.57 ± 3.05	26.13; 27.01
Length of hemodialysis	54.75 ± 31.27	50.21; 59.28
IDWL	1.90 ± 1.22	1.88; 2.20
Number of acute side effects	1.65 ± 1.08	1.49; 1.81
Depression	13.79 ± 8.97	12.49–15.09
Post-hemodialysis recovery time (min)	578.41 ± 402.27	520.06; 636.76

Table 2 Respondent distribution.

Variable and category	Frequency	%
Gender		
Male	110	59.5
Female	75	40.5
Hemodialysis schedule		
Morning	99	53.5
Afternoon	86	46.5
Kt/V		
Adequate $Kt/V \geq 1.2$	181	97.8
Non-adequate $Kt/V < 1.2$	4	2.2
Sodium dialysate levels		
<140 mEq/L	42	22.7
140 mEq/L	74	40
>140 mEq/L	69	37.3
Ultrafiltration rate		
<10 mL/kg/h	92	49.7
10–13 mL/kg/h	71	38.4
>13 mL/kg/h	22	11.9
ESRD comorbidities		
Hypertension and PNC	130	70.3%
Hypertension and heart failure	19	10.3%
Hypertension and DM	27	14.6%
DM, hypertension, and heart failure	5	2.7%
Hypertension and IMA	3	1.6%
Hypertension and Nefritis Lupus Eritematosus	1	0.5%

Table 3 Analysis of recovery time based on hemodialysis schedule.

Variable	Mean ± SD	Mean difference	*p* Value
Schedule			
Morning	518.42 ± 429.74	−129.04	0.029*
Afternoon	647.47 ± 358.26		

* *p* Value was significant at α 0.05 (p value < α).

recovery time, while the rest can be explained by other factors. Specifically, the most dominant factor associated with post-hemodialysis recovery time is acute side effects during hemodialysis ($\beta = 0.747$).

Linear regression line equation obtained

Post-hemodialysis recovery time = −272.55 + 28.85 gender + 5.16 upper-arm circumference + 72.12 hemodialysis schedule + 30.7 sodium dialysate concentration + 13.32 IDWL + 11.15 kidney failure comorbidities + 277.3 number of acute side effects during hemodialysis.

Discussion

The average age of the participants was 51.17 years old. Kidney failure patients with hemodialysis may be at a wide variety of ages, regardless of the underlying primary cause of kidney failure. This study found no significant association between age and post-hemodialysis recovery time. These results are in accordance with the research conducted by Awuah et al.,[13] Bossola et al.,[7] Lopes et al.,[14] and Smokovska et al.[12] Smokovska et al.[12] stated that it is possible that post-hemodialysis recovery time is not dependent on the age of respondents.

The average recovery time for male respondents was found to be faster, compared to female respondents. This appears to be in line with a study by Rayner et al.[11] that found male respondents had faster post-hemodialysis recovery times than female respondents. Current studies have found that females tend to experience unpleasant complaints, such as exhaustion, fatigue, and post-hemodialysis energy exacerbations that are more severe than those experienced by males; this may affect the length of post-hemodialysis recovery time.[15,16] The severity of complaints felt by female respondents correlates with sleep disorders that tend to be more commonly experienced by female patients.[17] Low levels of serotonin in females are believed to be correlated with sleep disorders.

Upper-arm circumference, in some studies, seems to be associated with survival rates of hemodialysis patients, but it is not categorized as a specific factor associated with post-hemodialysis recovery time. Upper-arm circumference does not seem sufficiently to reflect the patient's condition, while the recovery time is very volatile. Several studies, such as Bossola et al.[7] and Awuah et al.,[13] tried to include other anthropometric aspects, such as BMI, on post-hemodialysis recovery time, but their study results also indicated no significant differences. Therefore, other alternatives to assess patient nutritional status, such as albumin and hemoglobin levels, could be considered as specific measurements that

Table 4 Analysis of recovery time based on kidney failure comorbidities.

Variable	Mean ± SD	*p* Value
Kidney failure comorbidities		
1. Hypertension and PNC	532.12 ± 388.96	0.046*
2. Hypertension and heart failure	821.63 ± 451.01	
3. Hypertension and DM	629.70 ± 375.01	
4. DM, hypertension and heart failure	729.40 ± 366.25	
5. Hypertension and IMA	475.00 ± 546.10	
6. Hypertension and Nefritis Lupus Eritematosus	145	

* *p* Value was significant at α 0.05 (*p* value < α).

Table 5 Recovery time and number of acute side effects.

Variable	*R*	R^2	*p* Value
Number of acute side effects during hemodialysis	0.77	0.59	0.001*

* *p* Value was significant at α 0.05 (*p* value < α).

Table 6 Post-hemodialysis recovery time with depression.

Variable	*R*	R^2	*p* Value
Depression	0.213	0.045	0.004*

* *p* Value was significant at α 0.05 (*p* value < α).

reflect actual patient nutritional status, which can change rapidly.

Among several factors related to hemodialysis, such as length of hemodialysis, IDWL, hemodialysis schedule, Kt/V, dialysate sodium level, and ultrafiltration rate, only one factor was found to be associated with post-hemodialysis recovery time: hemodialysis schedule. These results are supported by Lopes et al.,[14] who found that patients on an afternoon hemodialysis schedule require a longer recovery time, compared to those on morning or night schedules. The underlying reasons for these findings remain unclear, although there is a trend of an almost-doubled prevalence of intra-dialysis hypotension in patients with afternoon hemodialysis schedule. Nevertheless, these results cannot be seen as the main reason for prolonged post-hemodialysis recovery time among patients on an afternoon hemodialysis schedule. Hemodialysis may affect sleepiness among patients during the hemodialysis process; the sleepiness is likely caused by interleukin-1. Patients who undergo an afternoon schedule and fall asleep during hemodialysis tend to have trouble falling asleep that night, post-hemodialysis. The study observations found that respondents tend to feel restless and stiff and have difficulty sleeping at night.

The results of this study seem quite surprising. There are several factors theoretically suspected to be associated with recovery time; this study demonstrated that those factors are not significantly associated with post-hemodialysis recovery time. No specific explanation has been found regarding the study results. IWLs are often correlated with large ultrafiltration volumes, when fluid movement occurs rapidly, such as when the ultrafiltration rate reaches more than 13 ml/kg/h, as then there is not enough time to fill the circulation volume. As a result, the patient may experience cramps, nausea, vomiting, headache, fatigue, or intra-dialysis hypotension. IDWLs are then considered to have an impact on the duration of post-hemodialysis recovery among patients.[18]

Regarding kidney failure comorbidities, the results of this study found a significant difference in recovery time among kidney failure comorbidity groups. Patients with heart failure comorbidity have a longer recovery time than others comorbidity groups. Presence of heart failure means the patients will certainly exacerbate an unpleasant complaint post-hemodialysis. This is because the heart failure can also systemically affect the patient's during hemodialysis process. The result of this study in line with the previous studies, which conducted by Bossola et al.[7] Bossola et al.[7] suggest that the presence of a comorbid burden on patients with hemodialysis may have an impact on post-hemodialysis recovery time. Rayner et al.[11] adds that among all kidney failure comorbidities, diabetes mellitus has a significant correlation with the duration of post-hemodialysis recovery.

The number of acute side effects during hemodialysis is one of the factors associated with post-hemodialysis recovery time. Acute side effects of hemodialysis include cramps, hypotension, hypertension, fatigue, pruritus, nausea, headache, etc. The presence of these side effects will make the patient feel uncomfortable, tired, and lacking energy after undergoing a hemodialysis session, so it may take some time to recover. Rayner et al.[11] found that post-hemodialysis recovery time had a correlation with pruritus, cramps, difficulty falling asleep, and depression. Bossola et al.[7,19] found fatigue after hemodialysis became an important factor in the length of post-hemodialysis recovery time of patients.

This study found that the most dominant factor associated with post-hemodialysis recovery time is the number of acute side effects during hemodialysis. Respondents tend to feel that they experience prolonged post-hemodialysis recovery time if they have acute side effects during hemodialysis. Acute side effects during hemodialysis may become actual problems for patients post-hemodialysis. Thus, this chief complaint is most likely to determine patients' recovery status post-hemodialysis.

The results lead to the conclusion that there are several factors related to post-hemodialysis recovery time, such as hemodialysis schedule, the number of acute side effects during hemodialysis, kidney failure comorbidities, and depression. In the next study, it is recommended that recovery time be measured not just once. It is necessary to observe the variation in post-hemodialysis recovery time. In addition, it is suggested that future research also study blood biochemical factors that may be associated with recovery time so can describe nutritional status of the patients more accurately.

Conflict of interests

The authors declare no conflict of interest.

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