

The Weekend Effect in Chronic Hemodialysis Patients, a Single Center Experience

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Introduction. It is not known whether there are any differences in dialysis outcomes of hemodialysis patients on Monday, Wednesday and Friday (MWF) schedule and patients on Tuesday, Thursday and Saturday (TTS) schedules. Patients on TTS schedule who receive one of the treatments on weekends may have worse outcomes compared with patients on MWF schedule as a result of weekend effect. In this study we compared the mortality and clinical performance measures for hemodialysis care, between patients on these two different hemodialysis schedules.

Methods. This single center study was conducted on chronic hemodialysis patients above 18 years of age at the time of initiation of hemodialysis who were under thrice weekly hemodialysis treatment for at least 12 months. Mortality and hemodialysis related quality indices were retrospectively compared between patients on MWF or TTS schedules.

Results. A total of 188 patients (114 male and 74 female) were included. The mean age of the patients at the start of dialysis was 50.9 ± 18.4 years and median hemodialysis vintage was 60.5 (12 to 369) months. Ninety-nine patients were on MWF schedule and 89 patients were on TTS schedule. More patients on MWF schedule reached the target laboratory values and patients on MWF schedule had a survival advantage compared with patients on TTS schedule.

Conclusion. Hemodialysis patients on MWF schedule may receive higher quality of care and may have better outcomes compared with patients on TTS schedule.

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INTRODUCTION

Hemodialysis is the most commonly used type of renal replacement therapy for the treatment of end stage renal disease (ESRD) and is typically scheduled thrice weekly either on Mondays, Wednesdays and Fridays (MWF) or Tuesdays, Thursdays and Saturdays (TTS). Several studies revealed increased risk of mortality on Mondays in MWF schedule and on Tuesdays in TTS schedule, as a result of longer interval between treatment sessions.¹⁻³

Weekend effect is defined as increased risk of adverse outcomes including higher mortality in several medical conditions associated with weekend patient admissions as a result of poorer quality of care in weekends.⁴⁻⁷ We hypothesized that hemodialysis patients on TTS schedule who receive one of the treatments on weekends at each week, may have worse outcomes compared to patients on MWF schedule because of weekend effect. The aim of this study was to compare the mortality and hemodialysis related quality indices between

hemodialysis patients on these two schedules.

MATERIALS AND METHODS

We reviewed records of all patients received maintenance hemodialysis in Hacettepe University Medical Faculty Hemodialysis Unit in the period between 1 June 2008 and 1 June 2018. Patients were included if they were above 18 years of age at the start of hemodialysis and received thrice weekly hemodialysis treatment for longer than 12 months. Patients on once weekly or twice weekly hemodialysis treatment and patients who received hemodialysis on both MWF and TTS schedules during the course of their diseases were excluded. The study was approved by the Local Ethics Committee of Hacettepe University Medical Faculty and was conducted in accordance with World Medical Association Declaration of Helsinki.

Hemodialysis sessions were performed three times a week for 4 to 5 hours. Dialysate flow was 500 mL/min, blood flow was 250 to 350 mL/min and net ultrafiltration volume was determined according to the estimated dry weight of each patient. Hemodialysis prescriptions were adjusted with the aim of $Kt/v > 1.4$ and urea reduction rate (URR) $> 70\%$. Pre dialysis target values for main laboratory parameters were as follows: hemoglobin, 11 to 12 g/dL; potassium, 3.5 to 5.5 mEq/L; phosphorus, 3.5 to 5.5 mg/dL; parathyroid hormone, 150 to 300 pg/mL; and ferritin, 200 to 500 ng/mL.

Age, sex, dialysis duration, etiology of ESRD, transplantation or death during follow-up, causes of mortalities, type of vascular access, hepatitis B immunization status, and use of antihypertensive medications were recorded for all subjects. Average of the all laboratory values for serum hemoglobin, potassium, calcium, phosphorus, c-reactive protein, ferritin, parathyroid hormone, URR, and Kt/v that were obtained within last one year were calculated. Frequency of hospitalization episodes during the last year of follow-up was also recorded. All of these parameters were compared between patients on two different hemodialysis schedules.

SPSS version 20 for Windows was used for statistical analysis. Normally distributed continuous variables were presented as mean \pm SD and non-normally distributed continuous variables were presented as median (min to max). Categorical variables were presented as frequencies and

percentages. Variables with normal distribution were compared by independent sample t-test and variables with non-normal distribution were compared by Mann-Whitney U test. Chi-square test was applied to test the differences between categorical variables. Kaplan-Meier test is used for survival analyses. $P < .05$ was accepted as statistically significant.

RESULTS

A total of 188 patients (114 male and 74 female) were included. The mean age of the patients at the start of dialysis was 50.9 ± 18.4 years while median hemodialysis vintage was 60.5 (12 to 369) months. The most common etiologies of ESRD were diabetes in 38 patients (20.2%), glomerulonephritis in 31 patients (16.5%), urological diseases in 24 patients (12.8%), polycystic kidney disease in 17 patients (9.0%), and amyloidosis in 13 patients (6.9%). The etiology was not clear in the majority of the patients (56 patients, 29.8%).

There were 99 patients on MWF schedule and 89 patients on TTS schedule. Demographical and clinical characteristics and laboratory results of the groups are presented in Table 1. The groups were similar with regard to the demographical characteristics and hemodialysis vintage. Prevalence of arteriovenous fistula, anti-HBs positivity and antihypertensive drug use were similar in two groups. In general laboratory parameters including URR and Kt/v were better in MWF group, but the differences did not reach statistical significance except for potassium which was significantly lower in patients on MWF schedule.

Percentage of the patients whose hemoglobin, potassium, phosphorus, parathyroid hormone, ferritin, URR and Kt/v levels were within target limits are presented in table 2 for both groups. Significantly less patients reached the targets for hemoglobin, potassium, URR and Kt/v in TTS group.

There were 36 mortalities in MWF schedule and 40 mortalities in TTS schedule during the follow-up. Mortality was significantly lower in patients on MWF schedule compared to patients on TTS schedule ($P < .05$ by log-rank, Figure). However, causes of mortalities were not different between the groups (Table 3). Mean number of one-year hospitalization episodes was also not different between patients on MWF and TTS schedules

Table 1. Demographic Characteristics, Hemodialysis Related Parameters and Laboratory Values of Patients on Two Different Hemodialysis Schedules

	MWF Schedule (n = 99)	TTS Schedule (n = 89)	P
Age, y	48.7 ± 18.3	53.5 ± 18.4	> .05
Gender, n (%)			
Male	59 (59.6%)	55 (61.8%)	> .05
Female	40 (40.4%)	34 (38.2%)	
Hemodialysis Vintage, mo	68 (12 to 369)	48 (12 to 353)	> .05
Vascular Access			
AVF	75 (75.8%)	68 (76.4%)	> .05
Catheter	24 (24.2%)	21 (23.6%)	
Anti-HBs Positivity, n (%)	80 (81.0%)	72 (81.0%)	> .05
Patients Treated with Antihypertensive Drugs, n (%)	18 (18.2%)	17 (19.1%)	> .05
Hemoglobin, g/dL	10.9 ± 1.1	10.8 ± 1.2	> .05
Potassium, mEq/L	5.1 ± 0.5	5.3 ± 0.6	< .05
Calcium, mg/dL	8.6 ± 0.7	8.7 ± 0.7	> .05
Phosphorus, mg/dL	4.8 ± 1.0	4.9 ± 1.0	> .05
Parathyroid Hormone, pg/mL	308 (6 to 1812)	298 (31 to 3131)	> .05
Ferritin, ng/mL	346 (20 to 2447)	325 (14 to 1462)	> .05
CRP, mg/dL	1.10 (0.19 to 10.70)	1.25 (0.10 to 16)	> .05
Urea Reduction Ratio, %	72.0 ± 5.9	70.4 ± 5.9	> .05
Kt/v	1.52 ± 0.25	1.48 ± 0.26	> .05

AVF, arteriovenous fistula; MWF, Mondays-Wednesdays-Fridays; TTS, Tuesdays-Thursdays-Saturdays

Table 2. Number of Patients that Reached the Target Laboratory Values on Two Different Hemodialysis Schedules

	MWF Schedule (n = 99)	TTS Schedule (n = 89)	P
Patients with 11 < Hb < 12, g/dL	32 (32.3%)	17 (19.1%)	< .05
Patients with K+ < 5.5, mEq/L	78 (78.8%)	54 (60.7%)	< .05
Patients with P+ < 5.5, mg/dL	74 (74.7%)	61 (68.5%)	> .05
Patients with 150 < PTH < 300, pg/mL	25 (25.2%)	25 (28.1%)	> .05
Patients with 200 < Ferritin < 500, ng/mL	55 (55.6%)	42 (47.2%)	> .05
Patients with URR > 70%	85 (85.9%)	66 (74.2%)	< .05
Patients with Kt/v > 1.4	58 (58.6%)	39 (43.8%)	< .05

MWF, Mondays-Wednesdays-Fridays; TTS, Tuesdays-Thursdays-Saturdays; URR, urea reduction ratio

(1.39 ± 1.78 vs. 1.42 ± 1.83, respectively; $P > .05$).

Transplantation rate was lower during follow-up for patients on TTS schedule (12 of 89 patients transplanted) compared to patients on MWF schedule (23 of 99 patients transplanted), however the difference was not statistically significant ($P > .05$).

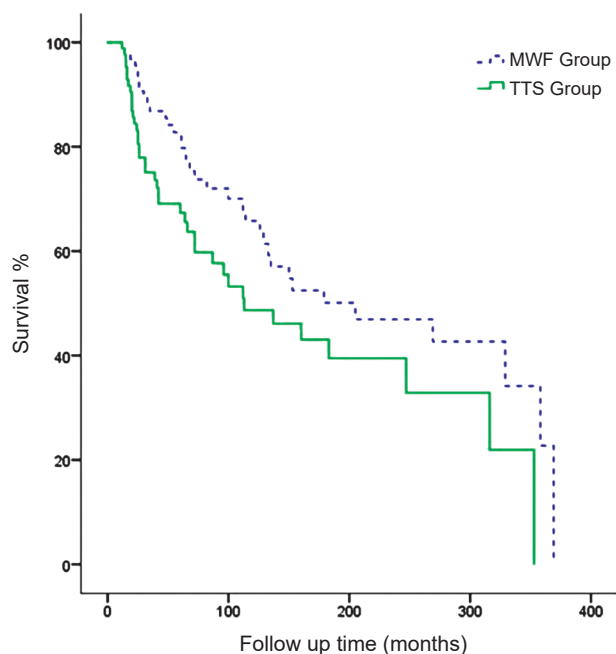
DISCUSSION

This study revealed that hemodialysis patients on MWF schedule who receive all dialysis treatments on weekdays may get higher quality of care and may have better outcomes compared to patients on TTS schedule who receive one of the dialysis treatments on weekends. We observed that many laboratory parameters were better and mortality

Table 3. Causes of Mortality of Patients on Two Different Hemodialysis Schedules

	MWF Schedule (n = 36)	TTS Schedule (n = 40)
Cardiovascular Events	12 (33.3%)	16 (40.0%)
Infections	9 (25.0%)	15 (37.5%)
Malignancy	4 (11.1%)	2 (5.0%)
Gastrointestinal Bleeding	3 (8.3%)	2 (5.0%)
Chronic Obstructive Lung Disease	3 (8.3%)	-
Cerebrovascular Accidents	2 (5.6%)	4 (10.0%)
Viscus Perforation	2 (5.6%)	-
Pulmonary Thromboembolism	1 (2.8%)	-
Traffic Accident	-	1 (2.5%)

MWF, Mondays-Wednesdays-Fridays; TTS, Tuesdays-Thursdays-Saturdays



It shows the effects of two different hemodialysis schedules on mortality (MWF: Monday-Wednesday-Friday, TTS: Tuesday-Thursday-Saturday).

was lower for patients on MWF schedule.

Main predictors of mortality for hemodialysis patients are increased age, dialysis vintage, presence of comorbidities (especially diabetes mellitus), malnutrition-inflammation-atherosclerosis (MIA) complex, inadequate dialysis (especially short effective session duration), loss of residual renal function, late referral to nephrologists, hypervolemia, central venous catheter use, anemia, hemoglobin variability and abnormal mineral metabolism.⁸⁻¹⁹ Most of these parameters are modifiable and achieving the goals recommended by clinical practice guidelines had been shown to decrease mortality in hemodialysis patients.²⁰ Current study revealed that patients on TTS schedule are less likely to achieve the hemodialysis related quality indices which may be responsible from higher mortality in this group of patients.

The worse outcomes in TTS group may be explained by several factors. These patients receive one session of hemodialysis in weekends. There is less nurse available during weekend sessions in hemodialysis units, which may result in suboptimal patient care and unexpected complications. Additionally, no nephrologist is usually present in weekends and this may cause delay in the management of complications.

Moreover, shortage of medical staff throughout the hospital together with unavailability of some diagnostic tests in weekends may be among the factors leading to higher morbidity and mortality in hemodialysis patients in Saturdays when unexpected complications develop. These patients may also have less access to dietary advice since dietitians are also not present in weekends.

Although previously no study specifically evaluated the differences in clinical performance measures of patients on different hemodialysis schedules, some studies indicated that level of patient care may have an effect on outcomes for hemodialysis patients. Less number of nurses per patients in hemodialysis units was shown to be associated with more complications, shorter dialysis sessions and dissatisfaction of patients.²¹ In a study by Harley *et al.* mortality was higher for patients cared by nephrologists with higher number of patients followed, compared to patients cared by nephrologists with lower patient numbers. Additionally, dialysis adequacy and transplantation rates were higher for patients cared by nephrologists with lower patient caseload.²² Another study reported higher mortality for hemodialysis patients receiving treatment in units with less than 15 hemodialysis machines.²³ Finally, mortality is higher in hemodialysis patients who are living away from their nephrologists compared to hemodialysis patients who live closer to their nephrologists.²⁴ These studies can be considered as indirect evidences of the effect of suboptimal care in TTS schedule on mortality and other hemodialysis related quality indices.

The limitations of this study are low number of included patients and being a single center study. Practices in this center may not exactly reflect the general practices in other hemodialysis centers.

CONCLUSION

The results of this study may at least create a suspicion that there may be some disparities in patient care in two different sessions (MWF vs. TTS) and further studies must be performed to rule out this doubt.

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