RESEARCH ARTICLE

Effect of different dialysate temperatures on post dialysis fatigue in patients undergoing haemodialysis: a quasi-experimental study

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Abstract

Objective: To compare the effects of warm and cold dialysate solutions on the duration of post-dialysis fatigue in patients undergoing maintenance haemodialysis.

Method: The quasi-experimental study was conducted at the Department of Nephrology, Pak Emirates Military Hospital, Rawalpindi, Pakistan, from May 9 to September 10, 2023, and comprised adult patients of either gender undergoing maintenance haemodialysis for a minimum of 3 months. The patient initially underwent haemodialysis with a dialysate temperature of 36°C for 2 weeks. During the subsequent washout period of one week when the dialysate temperature was not monitored, they underwent haemodialysis with a dialysate temperature of 37°C for another 2 weeks. Blood pressure was monitored every 30 minutes to record any hypotensive episodes. Patients were asked if they felt fatigued after the last haemodialysis session, and the duration was noted down. Data was analysed using SPSS 24.

Results: Of the 92 patients with mean age 49.1±16.1 years, 57(62%) were males. Post-dialysis fatigue was seen in 67(72.8%) and 75(81.5%) patients with dialysate temperatures at 36°C and 37°C, respectively (p<0.001). The duration of post-dialysis fatigue was also significantly longer at dialysate temperatures 37°C p<0.001). There was no significant difference in the proportion of hypotensive episodes in the two groups (p=0.445).

Conclusion: Dialysate temperature 36°C was found to be associated with less frequent and shorter duration of post-dialysis fatigue compared to dialysate temperature 37°C.

Key Words: Cold temperature, Fatigue, Haemodialysis, Haemodialysis solutions, Hypotension, Renal replacement therapy.

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Introduction

Patients with end-stage renal disease (ESRD) require some form of renal replacement therapy (RRT) to sustain life. Given various limitations of healthcare delivery in the developing world, haemodialysis (HD) remains the preferred modality of treatment, but even facilities for this do not comprehensively cover the requirements of 150 people per million ESRD population in Pakistan each year.[1] Some nephrologists have already questioned the feasibility of HD in local setups.[2]

Like any other medical intervention, HD in itself is not without risks or complications. Many people feel exhausted after individual sessions, and improve with rest or sleep. This phenomenon, called post-dialysis fatigue (PDF), is seen in around 50- 85% patients.[3] It may be associated with myriad phenomena, such as functional disability, myocardial ischaemia, impaired quality of life, poor compliance to treatment, higher hospital admission rates, and an increased risk of mortality.[4] Given these concerns, it is not surprising to see the amount of effort that has been put in by clinicians and researchers around the globe to find solutions for reducing PDF.

Different patient characteristics, such as older age, female gender and shorter HD vintage, could be used to predict PDF, but they are not modifiable factors.[5] Improving nutritional status, treating anaemia and enhancing the adequacy of individual HD sessions could be beneficial for these patients.[6] In addition, various modifiable treatment-related factors, such as frequency of HD sessions, ultrafiltration volumes as well as dialysate temperatures and sodium concentration, could be potential targets for alleviating PDF.[7] Different studies have been carried out to assess the effect of lowering dialysate temperatures on haemodynamic stability and PDF internationally, but local data is still missing.[8] The current study was planned to fill the gap by determining the effectiveness of colder dialysate in improving PDF among Pakistani patients.

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Patients and Methods

The quasi-experimental study was conducted at the Department of Nephrology, Pak Emirates Military Hospital (PEMH), Rawalpindi, Pakistan, from May 9th to September 10th, 2023. After approval from the institutional ethics review committee the sample was calculated with 80% power, 5% probability of type I error, PDF duration 9.9±6.3 hours with warm dialysate and 1.4± 0.9 hours with cold dialysate[9] with the help of Epitools calculator for comparison of two means with unequal variances.[10]

All potential participants were initially screened for eligibility in line with the Transparent Reporting of Evaluations with Nonrandomised Designs (TREND) statement.[11] Those included were adult patients aged 18 or more years of either gender undergoing regular adequate maintenance HD for a minimum of 3 months. Adequacy in this context was defined as Kt/V ≥1.2 documented in one of the sessions during the month preceding the current enrolment. Patients with ongoing infection or sepsis, dementia, sleep disorders, aphasia as a result of previous stroke, limited mobility, active cancer, shortened HD sessions, infrequent dialysis irrespective of the reason, or unwillingness to participate were excluded. Patients were enrolled using consecutive sampling technique after taking informed written consent.

Baseline demographic parameters were noted down for all the patients, and they initially underwent HD with a dialysate temperature of 36°C for 2 weeks. There was a washout period of 1 week during which the setting of dialysate temperature was left at the discretion of dialysis nurses, and this was not monitored. Subsequently, all patients crossed over into the other arm of the study, wherein they underwent HD with a dialysate temperature of 37°C for the next 2 weeks. Throughout the duration of this study, the patients were not aware of the dialysate temperature settings. During the second week of each arm, blood flow rates were recorded along with ultrafiltration volumes. Blood pressure was monitored every 30 minutes during all the HD sessions to record any hypotensive episode.

The patients were asked in Urdu, the local language, if they felt fatigued after the last HD session, and the duration was noted down. All patients had conventional HD with low flux dialysers (Fresenius F10 Dialyser, Fresenius Medical Corporation, Germany). Apart from the ultrafiltration volumes that were dictated by the interdialytic weight-gain, all other parameters for HD prescription were kept uniform for all patients, including a duration of 4 hours, blood flow rate of 350ml/min and dialysate flow rate of 500ml/min during all HD sessions.

Data was analysed using SPSS 24. Continuous data was presented as mean ± standard deviation or median and interquartile range (IQR), depending upon data normality. Wilcoxon signed-rank test was used to compare non-parametric continuous variables between the two dialysate temperature groups. Categorical variables were expressed as frequencies and percentages, and were compared using chi square or Fisher's exact test. P<0.05 was considered significant.

Results

Of the 105 patients screened, 94(89.5%) were enrolled, and, of them, 92(98%) completed the study (Figure). The mean age of the patients was 49.1±16.1 years. There were 57(61.9%) males and 35(38%) females. Vascular access used for HD was arteriovenous fistula in 73(79.3%) patients, and tunnelled dialysis lines in 19(20.6%) (Table 1).

PDF was reported by 67(72.8%) and 75(81.5%) patients with dialysate temperatures at 36°C and 37°C, respectively (p<0.001). The duration of PDF was also significantly longer at dialysate temperature 37°C

Table-1: Baseline characteristics.

Variable	Value
Age (years)	49.1± 16.1
Gender	
Male	57 (62.0%)
Female	35 (38.0%)
Education (median; years)	10 (5-10)
Haemodialysis vintage (median; years)	14.2 (10.2- 21.0)
Vascular access	
Arteriovenous fistula	73 (79.3%)
Tunnelled dialysis line	19 (20.6%)
Co-morbidities	
Diabetes Mellitus	37 (40.2%)
Hypertension	85 (92.4%)
Ischaemic heart disease	13 (14.1%)
Liver cirrhosis	3 (3.3%)

Table-2: Intergroup comparison of dialysis outcomes.

Parameter	Dialysate temperature 36 0C	Dialysate temperature 37 0C	P
Post-dialysis fatigue (n, %)	67 (72.8%)	75 (81.5%)	<0.001
Duration of post-dialysis fatigue (median and IQR; minutes)	135 (0- 300)	240 (60- 562.5)	<0.001
Ultrafiltration volume (median and IQR; Litres)	2.0 (1.5- 2.5)	2.0 (1.2- 2.5)	0.439
Intra-dialytic hypotension (n, %)	5 (5.4%)	10 (10.9%)	0.445

IQR: inter-quartile range.

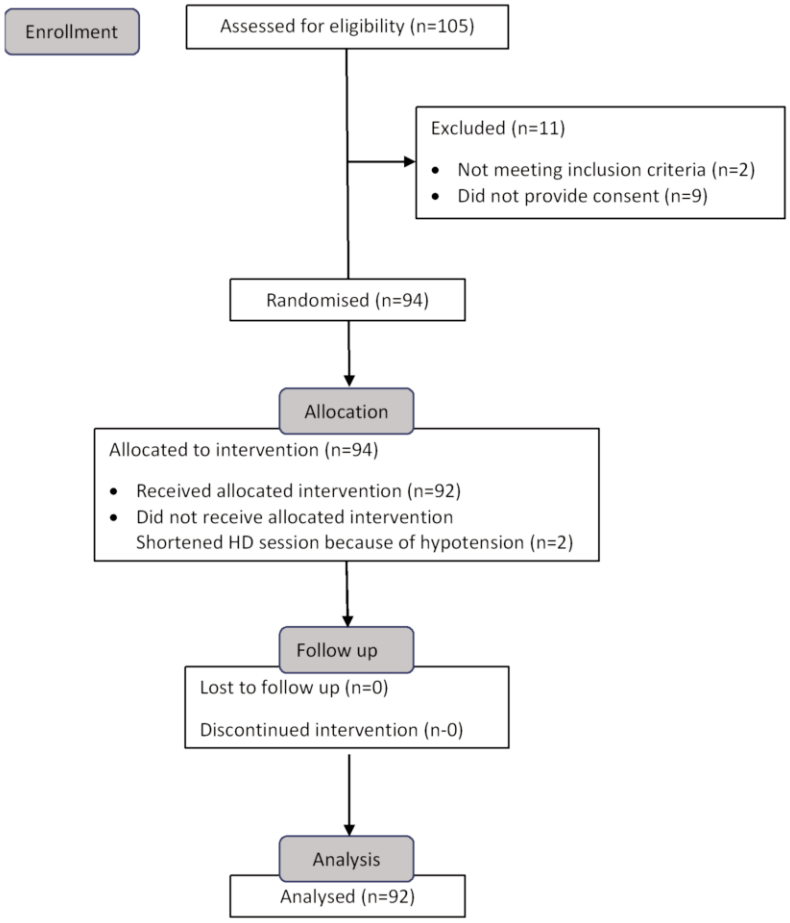

Figure: Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) flowchart.

(p<0.001). There was no significant difference in terms of hypotensive episodes and ultrafiltration volumes at the two temperatures (Table 2).

Discussion

The current study showed PDF to be a less frequent and less severe problem amongst patients undergoing HD with a colder dialysate. A minimal reduction of 1°C in dialysate temperature decreased the median duration of PDF by 105 minutes. PDF is believed to be caused by the release of pro-inflammatory cytokines, following an interaction of mononuclear cells in peripheral blood with dialyser membranes.[12] The most plausible explanation for the beneficial effects of cold dialysate seen in the current study was better left ventricular contractility and enhanced cardiac output leading to improved tissue perfusion.

The current results were comparable to studies previously done in other parts of the world, including Spain[13,] Iraq[14] and Egypt.[9]

The magnitude of reduction in dialysis recovery time (DRT) could not be directly compared with literature because of differences in dialysate temperatures between the two arms of earlier studies[9,13,14]. Also, the variations in ultrafiltrate volumes during HD sessions could also have played some role in the disparity. However, the direction of change in DRT has been consistent across all these studies[9,13,14].

In contrast, some studies have suggested that there was no relationship of dialysate temperature with DRT.[15,16]

Another important finding of the current study was the reduction in intradialytic hypotension with the use of a colder dialysate. This was in keeping with the results of a meta-analysis of 26 trials having 484 patients.[17] There was 70% lesser incidence of hypotension and a 12mmHg elevation in mean arterial pressure when patients were haemodialyzed with dialysate at reduced temperature. The findings were important considering the importance of intradialytic hypotension as an independent risk factor for cardiovascular mortality amongst patients with ESRD.[18]

Chronic kidney disease (CKD) affects patients of all age groups. In the current study, the mean age of the patients was 49 years, which was comparable to results reported earlier.[19] PDF remains a major concern in such patients not only because it negatively affects compliance, but because of interference with lifestyles and ability to comfortably engage in work-related activities by people in the prime of their life.[20]

There are different ways to assess and quantify PDF, with at least 9 different scales documented in literature.[4] The easiest amongst these is the simple question that the current study used, and the quantification of time required to recuperate from the ill-effects. Many studies have previously used the same strategy globally.[21, 22] This approach has previously been shown to be easily comprehended by the patients and having a good test-retest reliability.[23] On the other hand, some questionnaires have also been designed to measure chronic fatigue, which is a somewhat different concept. Standardised Outcomes in Nephrology- Haemodialysis (SONG-HD) is a patient-reported outcome measure that has been validated in some studies.[24, 25] Being in English, most of the questionnaires could have been difficult to handle for the current patients, and would have required

trained staff for administration in daily practice. Even then, acquisition of complete information could have remained a tedious task.

The current study has certain limitations, including observer bias. Similarly, potential confounding factors leading to PDF, including anaemia, vitamin D and calcium deficiency, were not adequately addressed in the study. The study sample did not reflect all ethnicities inhabiting Pakistan. Moreover, data was collected from a single HD centre.

Despite the limitations, the current study gave an interesting insight into patients' feelings and perception about a treatment they require to sustain life. Modifications in treatment regime and HD prescription affect DRT, and routine periodic assessment may provide feedback on the quality of HD treatment.

Conclusion

A cooler dialysate was found to be associated with less frequent and more short-lived episodes of PDF amongst patients undergoing maintenance HD. The strategy could be easily applied to alleviate discomfort among the affected patients at no additional cost.

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Authors' Contribution:
AA: Concept, design, data collection, revision and final approval.
ARA: Concept, data acquisition, analysis, revision and final approval.
MAS: Design, drafting and final approval.
MZS: Data acquisition, analysis, revision and final approval.
MI: Data analysis, interpretation, drafting and final approval.
MA: Design, data acquisition, drafting and final approval.