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Combination of sodium and ultrafiltration profiles for prevention of intradialytic hypotension and related symptoms

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ABSTRACT

Intradialytic hypotension is the most common complication of haemodialysis (HD). This study on the effect of profiled hemodialysis on intradialytic hypotension(IDH) and related symptoms,nursing interventions during dialysis. Evaluated intradialytic hypotension related symptoms included muscle cramps, dizziness, headache,nausea and vomitting. Evaluated nursing interventions included saline infusion,decrease or stop ultrafiltration(UF) and session failure. In this study interdialytic weight and serum sodium concentration were evaluated also. This study included 24 patients on maintenance haemodialysis who experienced frequent episodes of intradialytic hypotension were recruited. There were 17 female and 7 male patients. There was significant improvement of IDH($p<0.001$) ,cramps($p<0.001$) ,dizziness($p<0.001$), headache($p<0.001$),saline infusion ($p<0.001$),decreaseor stopUF($p<0.001$),session failure($p<0.001$). No significant difference in interdialytic weight, serum sidium concentration, nausea and vomitting.

Key words : Intradialytic hypotesion, sodium profiles, ultrafiltration profiles.

INTRODUCTION

Chronic Renal Failure (CRF) is a pathophysiologic process with multiple etiologies,that leads to the irreversible reduction of renal function and End Stage Renal Disease (ESRD). Life expectancy and avoiding from life-threatening complications in ESRD patients depends on Renal Replacement Therapy (RRT), dialysis or transplantation (Yadavar 2005). Haemodialysis is a common treatment for ESRD worldwide (Mahdavimazdeh et al., 2006) . Although, haemodialysis is a safe procedure, it can cause some complications (Meira et al., 2007).

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Intradialytic Hypotension (IDH) is a common complication during the dialysis (Ramos et al., 2007) and occurs in 20-33% of haemodialysis patients (Kaczmarczyk et al., 2007), Although it has been reported in up to 50% of patients in some studies. Intradialytic Hypotension is defined as decreases in systolicblood pressure more than 30% or decrease in diastolic pressure less than 60 mmHg or systolic blood pressure < 90 mmHg during dialysis. IDH is characterized with muscle cramps, dizziness, nausea, vomiting, headache, weakness, blurred vision and fatigue during haemodialysis (Tang et al., 2006). IDH widely increases the morbidity of dialysis (Germin et al., 2003). Moreover it increases the need for nursing cares (Santoro et al., 2002) and has negative effect on patients' quality of life (Song et al., 2005). Therefore prevention of IDH, is one of the main challenges for nursing staffs (Abbas et al., 2007).

PATIENTS AND METHODS

Patients:

The study was conducted in the Dialysis Centre at Almowasah University Hospital, Alexandria University

Hospitals and Alexandria Police Hospital, Alexandria, Egypt from February 2015 to April 2015. 24 patients on maintenance haemodialysis who experienced frequent episodes of intradialytic hypotension were recruited. There were 17 female and 7 male patients.

Inclusion criteria were :

1. Patients age ranges from 28 to 60 years.
2. Patients were maintained on haemodialysis, three sessions of haemodialysis per week each for four hours using bicarbonate containing dialysate for more than three months.
3. Patients experienced frequent episodes of hypotension.

Exclusion criteria were:

-Patients on antihypertensive medications.

Methods:

The study was a two-period, two-treatment crossover design with repeated measures. Patients were randomized to start with 4 weeks of standard(conventional) dialysis with constant sodium concentration of 140 mEq/L with constant UF rate . At the end of the first 4 weeks, the patients immediately crossed over to another 4 weeks of profiled dialysis (step-down sodium and UF profiles). Sodium Profiling Method: The starting sodium concentration was set at 145 mEq/L and falling to 138 mmol/l at the end of dialysis. Then, the module proceeded with the profile automatically while maintaining the time-averaged mean of dialysate sodium concentration at 141 to 142 mEq/L .UF Profiling Method:In the stepwise decreasing UF profile, the UF rate began with 1.5 x UF rate and decreased stepwise to 1.0 x UF rate in the next step and to 0.5 x UF rate in the final step. All treatments were performed using FMC 4008 S (Fresenius Medical Care AG,Bad Homberg, Germany) or Gambro AK 96 haemodialysis machines (Gambro, Lund, Sweden) and hollow-fiber dialyzers (F7 or L17). Blood flow rate was individualized from 200 to 350 ml/min (mean 293 ± 61 ml/min) and dialysate flow rate was 500 ml/min. Bicarbonate containing dialysate. Dialysate temperature was from 36.5 to 37°C. Anticoagulation of the extracorporeal circuit was achieved with systemic unfractionated heparin.

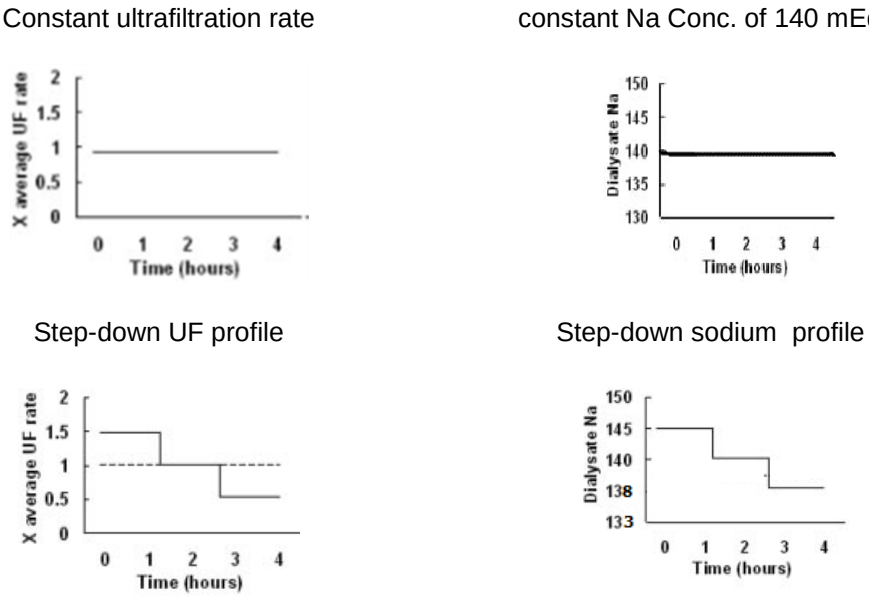
RESULTS

This cross-sectional study was performed in 24 subjects on maintenance haemodialysis. Demographic data of 24 subjects was shown in table-1. There was a reduction in intradialytic hypotensive episodes after switching to profiled sodium and ultrafilteration dialysis (Table 2). Intradialytic symptoms after switching to profiled sodium and ultrafiltration dialysis. Symptoms, including cramps, dizziness and headache were significantly reduced (Tables-3,4,5). All nursing interventions required to manage these complications included saline infusion, decrease or stop ultrafiltration (UF) and session failure were also significantly fewer during profiled sodium and ultrafiltration haemodialysis (Table 6,7,8). There was no significant difference in serum sodium level between constant and profiled dialysis (Table 9). No statistical difference in the interdialytic weight gain, nausea and vomiting between the two types of dialysis were observed (Table 10,11).

DISCUSSION

Although hemodialysis is a safe and useful procedure and increases patients' life expectancy, it has some complications. Intradialytic hypotension is the main complication during hemodialysis. In this study,

Figure-1. Constant sodium and ultrafiltration, step-down sodium and UF profiles



using of step-down sodium + UF profiles reported significant decrease in the incidence of intradialytic hypotension and related symptoms included, muscle cramps, dizziness and headache and all nursing interventions (saline infusion, decrease or stop UF, session failure) ($p<0.001$). The same findings were reported by (Song et al., 2005), (Tang et al., 2006), (Zhou et al., 2006), (oliver et al., 2001) and (Shahgholian et al., 2007).

Table-1. Distribution of the studied cases according to demographic data (n=24)

	No.	%
Gender		
Male	7	29.2
Female	17	70.8
Age (years)		
≤40	5	20.8
>40	19	79.2
Min. – Max.	28.0 – 60.0	
Mean ± SD	49.08 ± 9.01	
Median	52.0	
Dry weight (Kg)		
Min. – Max.	48.0 – 100.0	
Mean ± SD	69.33 ± 15.51	
Median	69.50	
BMI (kg/m^2)		
Min. – Max.	18.29 – 36.73	
Mean ± SD	25.98 ± 5.24	
Median	25.06	

Table-2. Descriptive analysis of the studied cases according to hypotensive episodes.(n=24)

	Hypertension N.			
	Standard	**Profiled**	**Z**	**p**
Min. – Max.	2.0–9.0	0.0–4.0	4.318*	<0.001*
Mean ± SD	4.50 ± 1.82	1.71 ± 1.23		
Median	4.0	2.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-3. Descriptive analysis of the studied cases according to cramps n. (n=24)

	Standard	**Profiled**	**Z**	**p**
Cramps n.				
Min. – Max.	0.0 – 5.0	0.0 – 2.0	3.572*	<0.001*
Mean ± SD	1.58 ± 1.50	0.38 ± 0.58		
Median	1.50	0.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-4. Descriptive analysis of the studied cases according to dizziness n (n=24)

	Dizziness N.			
	Standard	**Profiled**	**Z**	**p**
Min. – Max.	0.0 – 6.0	0.0 – 3.0	4.071*	<0.001*
Mean ± SD	2.58 ± 1.67	0.83 ± 0.92		
Median	2.50	1.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-5. Descriptive analysis of the studied cases according to headache n. (n=24)

	Headache N.			
	Standard	**Profiled**	**Z**	**p**
Min. – Max.	0.0 – 6.0	0.0 – 2.0	3.808*	<0.001*
Mean ± SD	1.83 ± 1.63	0.54 ± 0.78		
Median	2.0	0.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-6. Descriptive analysis of the studied cases according to saline bolus N. (n=24)

	Saline bolus N.			
	Standard	**Profiled**	**Z**	**p**
Min. – Max.	0.0 – 6.0	0.0 – 4.0	3.950*	<0.001*
Mean ± SD	2.88 ± 1.51	1.21 ± 1.06		
Median	3.0	1.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-7. Descriptive analysis of the studied cases according to dec. or stop UF N. (n=24)

	Dec.or stop UF N.			
	Standard	**Profiled**	**Z**	**p**
Min. – Max.	3.0 – 9.0	0.0 – 5.0	4.326*	<0.001*
Mean ± SD	5.04 ± 1.73	1.88 ± 1.30		
Median	5.0	2.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-8. Descriptive analysis of the studied cases according to session failure N. (n=24)

	Session failure N.			
	Standard	Profiled	Z	p
Min. – Max.	0.0 – 4.0	0.0 – 2.0	3.729*	<0.001*
Mean ± SD	1.46 ± 1.14	0.42 ± 0.65		
Median	1.50	0.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled
*: Statistically significant at p ≤ 0.05

Table-11. Descriptive analysis of the studied cases according to N.&V. n. (n=24)

	N.&V. n.			
	Standard	Profiled	Z	p
Min. – Max.	0.0 – 3.0	0.0 – 3.0	1.512	0.131
Mean ± SD	0.71 ± 0.95	0.42 ± 0.83		
Median	0.0	0.0		

Z, p: Z and p values for Wilcoxon signed ranks test for comparing between standard and profiled

On the contrary with our study Hamzi et al., (2012) reported that, sodium profile alone or in combination with UF profile is not an efficient approach to decrease dialysis-related hypotension, related symptoms and nursing interventions.

In our study we reported that no significant difference in intradialytic nausea, vomiting and serum sodium between standard and profiled dialysis.

CONCLUSION

In conclusion, combination of step-down sodium and ultrafiltration profiles are simple and cost effective methods which improve the homodynamic stability with modulating the sodium dialysate and removal of fluids, so decreases the incidence of IDH and related symptoms (dizziness, cramps, head-ache). Also decreasing all nursing interventions (saline infusion, decreasing or stopping ultrafiltration, session failure) with improvement of dialysis tolerance. Without significant interdialytic weight gain or sodium gain. Therefore combination of sodium and ultrafiltration profiles is recommended for IDH prevention.

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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Table-9. Descriptive analysis of the studied cases according to serum sodium (mEq/L) (n=24)

	Standard	Profiled HDX		
		2weeks pre	2weeks post	Post study
Serum Sodium /mEq/L				
Min. – Max.	126.0–147.0	126.0–147.0	124.0–151.0	127.0–148.0
Mean ± SD	136.75 ± 4.36	137.63 ± 4.60	138.42 ± 5.57	137.46 ± 4.69
Median	137.0	138.0	139.0	137.5
p		0.178	0.049*	0.727

Sig. bet. Periods was done using ANOVA with repeated measures
p: Stands for (adjusted Bonferroni) p-value for ANOVA with repeated measures for comparison between standard with each other period
*: Statistically significant at p ≤ 0.05

Table-10. Descriptive analysis of the studied cases according to interdialytic weight gain/Kg (n=24)

	Standard HDX	Profiled HDX	t	p
Interdialytic weight Gain /Kg				
Min. – Max.	1.0 – 5.0	1.50 – 5.0	0.090	0.929
Mean ± SD	3.02 ± 0.99	3.03 ± 0.91		
Median	2.50	3.0		

t, p: t and p values for Paired t-test for comparing between standard and profiled

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