

Effect of Blood Flow Rate on Dialysis Adequacy in Al-Kadhimiya Teaching Hospital

Ehab J Ghali¹ MBChB CABM, Arif S Malik² MBChB FICMS

¹Dept. of Medicine, Al-Kadhimiya Teaching Hospital, ²Dept. of Medicine, College of Medicine, Al-Nahrain University, Baghdad, Iraq.

Abstract

Background Adequacy of dialysis is one of determinants of morbidity and mortality. The Blood flow rate is one of important factors of adequacy of dialysis in patients with Hemodialysis.

Objectives To assess the effect of blood flow rate on adequacy of dialysis.

Methods Seventy patients maintained on regular Hemodialysis in the dialysis unit, Al-Kadhimiya Teaching Hospital. Their body weight and blood urea level before and after hemodialysis sessions were recorded, volume of ultra-filtration, duration of dialysis and blood flow rate were documented in a checklist. Both (kt/v) and (URR) were determined at three different pump speed (150-200), (201-250) and (251-300) ml/min. During hemodialysis, the hemodynamic status and vital signs of patients were monitored and controlled.

Results Efficiency of dialysis was calculated using the standard formulas. Paired t-test showed no significant difference in dialysis efficiency between the three groups.

Conclusion Higher rate of inadequacy of hemodialysis, and no significant correlation was observed between BFR groups.

Key words Hemodialysis, Blood flow rate, Adequacy of dialysis

Introduction

Patients with end stage renal disease are unable to sustain life without dialysis support⁽¹⁾. Hemodialysis, refer to the transport process by which a solute passively diffuse down its concentration gradient from one fluid compartment (either blood or dialysate) into the other⁽²⁾. During (HD), the waste products and electrolytes move between the dialysate and blood⁽³⁾. The dialysate flow is countercurrent to blood flow through the dialyzer to maximize the concentration gradient between the compartments and therefore to maximize the rate of solute removal⁽⁴⁾.

Dialysis delivery should be adequate to not only improve quality of life and also to prolong survival⁽⁵⁾. The aims of dialysis are thus, to

decrease morbidity, increase quality of life and prolong life span⁽⁶⁾. To achieve these aims, dialysis must be performed effectively, effective (HD) is one of important factors that plays a role in decreasing morbidity and mortality of patients⁽⁷⁾, and in effective dialysis is one of factors causing mortality of these patients⁽⁸⁾. There are many surveys that indicate the relationship between dose of dialysis and morality of patients; they concluded that inadequate dose of dialysis increase duration of hospitalization and over all cost of care and complications⁽⁹⁾.

One method of assessing dialysis dose is calculation of (kt/v). This index reflects the efficiency of dialysis and correlated with mortality and morbidity rate of patients⁽¹⁰⁾.

Dialysis dose can also be assessed measuring the urea reduction ratio (URR) ⁽¹¹⁾. The (URR) can be assessed by measuring the blood urea level before and after dialysis ⁽¹²⁾.

The results of many surveys show that achieving a (kt/v) of (1.2-1.3) or more and (URR) of (65%) or more is effective in improving prognosis of patients on (HD) ⁽¹³⁾. Therefore achieving this goal remain are the aims of dialysis. Many factors can increase (kt/v) and (URR) including use of high quality filter, increase blood flow rate (BFR), increase flow of dialysate and dialysis time ^(14,15).

Increasing duration of dialysis is a useful method for increasing (kt/v), but it is not always possible because of economic factors and intolerance of patient ⁽¹⁶⁾. Also, increasing the flow rate of dialysis leads to increase diffusion of urea from blood to the dialysate, but the affect cannot be prolonged ⁽¹⁷⁾.

According to united state Renal Data system (USRDS), increasing (kt/v) by 0.1 can result in reducing partial risk of cardiovascular system and infections ⁽¹⁸⁾, and each (0.1) reduction of (Kt/v) can increase mortality by (5-7) years in dialysis patients ⁽¹⁹⁾, available literature suggest that usage of more effective dialyzer and increase BFR and Increase dialysis duration can all increase efficiency of Hemodialysis ⁽²⁰⁾.

It should be remembered that increase of BFR not always lead to highest clearance of blood urea, thus increasing BFR by (100%) from 200 ml/min to 400 ml/min can increase blood urea clearance by 33% ⁽²¹⁾.

The study intended to assess the effect of blood flow rate on adequacy of hemodialysis in patients with (ESRD) under going regular (HD).

Methods

The study was carried out on samples of patients (cross sectional study) in dialysis unit at Al-Kadhimiya Teaching Hospital, assessment of adequacy of HD in patients with ESRD underwent different range of BFR during HD, which are (150-200), (201-250) and (251-300) ml/min.

Patients' selection

70 patients were selected randomly, 46 males and 24 females, with age range between (28-70) years (48±13 mean and SD) on regular on hemodialysis sessions a bout (2-3) sessions per week (2.6±0.4, mean and SD), and each session lasting (2-4) hours (3.3±0.4 mean and SD) the vascular access used was an arterio-venous fistula in (55) patients, and dual lumen catheter in subclavian vein in (15) patients, ethically there were acceptances from the patients

Methods

BFR was grouped in three readings which are (150-200), (201-250) and (251-300) ml/min and the patients were classified patient according to these groups.

Dialysis machine used is GAMBRO AK95S and all patients used hollow fiber dialyzer (GAMBRO) with synthetic membrane; surface area (1.5-1.7) m². The dialysate fluid consisted of flowing constituents sodium 140 mmol/l, potassium 2.0 mmol/l, calcium 1.5 mmol/l, magnesium 0.5 mmol/l, chloride 111.0 mmol/l, bicarbonate 32.0 mmol/l, acetate 3 mmol/l, osmolality 290 mmol/l and dialysate flow rate 500 ml.

In dialysis sessions patient body weight (pre and post dialysis) were recorded and ultrafiltration pressure, trans- membrane pressure and BFR recorded from machines.

During HD, the Clinical vital signs (pulse rate, blood pressure and temperature of patients) were recorded and controlled appropriately.

Dialysis efficacy was measured by using two types of formula which are (URR) and (kt/v) and this formula as follow ⁽¹⁴⁾

$$\text{URR} = (\text{urea pre} - \text{urea post} / \text{urea pre}) * 100\%$$

Where URR is ratio of the relationship between two different numbers or quantities, Urea that uses is BUN, BUN = blood urea / 2.141

Another formula is $\text{kt/v} = -\ln(1 - \text{URR})$

Where K refer to dialyzer clearance, T = time of dialysis, V refer to pt. body water volume.

Statistical analysis

Statistical analysis was performed using SPSS14.0 the Chi-square (X) test was used, p-value < 0.05 were considered as statistically significant.

The main possible causes of renal failure in this study group were hypertension they were 50% of patients and the least was glomerulonephritis.

Results

Table 1. Prevalence of the main possible causes of CKD on HD

Etiology of CKD	No. of patient	Percentage
Hypertension	35	50%
DM	25	36%
Unknown	5	7%
Pylonephritis	3	4%
GN (on clinical and histopathological base)	2	3%

GN = glomerulonephritis

The URR 65% or more were six patients at BFR (150-200), (10) patients at BFR (201-250) and Five patients at BFR (251-300) ml/min. The (Kt/v)

1.3 or more in two patients at BFR 150-200, two patients at BFR (201-250) ml/min and one patients at BFR (251-300) ml/min.

Table 2. Distribution of patients according to URR in three different BFR

URR		BFR (ml/min)			P. value
		150-200	201-250	251-300	
< 65%	Mean±SD	57.3 ± 5.19	56.40 ± 5.97	56.50 ± 5.06	0.258
	%	(13%)	(43%)	(14%)	
	No.	9	30	10	
> 65%	Mean±SD	76.6 ± 1.63	87.8 ± 2.30	67.6 ± 2.40	0.01
	%	(9%)	(14%)	(7%)	
	No.	6	10	5	
Patient No.		15(22%)	40(57%)	15 (21%)	70

Table 3. Distribution of patients according to Kt/v in three different BFR

(Kt/v)		BFR(ml/min)			P. value
		150-200	201-250	250-300	
0.5-0.8	Mean±SD	0.65 ± 0.105	0.64 ± 0.093	0.59 ± 0.068	0.821
	%	(11.5%)	(28.5%)	(7%)	
	No.	8	20	5	
0.9-1.2	Mean±SD	1.03 ± 0.12	1.01 ± 0.107	0.97 ± 0.075	0.765
	%	(7%)	(30%)	(8.5%)	
	No.	5	21	6	
>1.3	Mean±SD	1.45 ± 0.071	1.4 ± 0.14	0.1 ± 0.01	0.45
	%	(3%)	(3%)	(1.5%)	
	No.	2	2	1	
Patient No.		15(21.5%)	43(61.5%)	12(17%)	

Discussion

The current study found that higher rate of inadequacy of hemodialysis mainly in the group of (201-250) BFR and there were no significant difference between BFR groups.

The current result of the study run in contrast with the findings of Kim and his colleagues showed that by increasing the BFR by 15-20 % in patients with low efficiency dialysis (kt/v less than 1.2), efficiency of dialysis would increase⁽²²⁾ According to study of S.R Borzou and his colleagues that increase BFR will increase efficiency of HD which in turn will reduce the morbidity and mortality of patients on HD⁽²³⁾.

Taziki, Lesan, Chaara and bloombergen and their colleagues assessed the effectiveness of increase BFR on clearance of potassium and phosphate with dialysis and showed that increase clearance the BFR was effective in increase clearance of potassium but was not effective in phosphate clearance⁽²⁴⁻²⁷⁾.

The explanation of higher rate of inadequacy of HD in current study despite using high rate of BFR are different factors not only the difference in blood flow rate:

Malnutrition, anemia, short time of dialysis session, premature cessation of sessions of HD , infection, inadequate blood flow from vascular access, hypotension episodes, technical reasons, the design of the study and the sample size might play a role .

In conclusion there were high rate of inadequacy of hemodialysis, and no significant effect of increasing blood flow rate on hemodialysis adequacy

The low dose of dialysis / week plays an important role in this result.

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Correspondence to Dr. Arif S Malik
E-mail: dr_arif31@yahoo.com
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