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The Effect of Postural Changes on the Blood Velocity, Blood Pressure and Hemoglobin during Hemodialysis

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Abstract: *The hemodialysis (HD) is medical procedure that use a special machine (dialysis machine) to filter water products from the blood and to restore its normal constituents. Many patients during dialysis develop hypotension, so this will lead to cessation of the session of hemodialysis . Dialysis hypotension is estimated to occur in 20% of (HD) session.*

0bjective: *to assess the effect of changing position on blood velocity, blood pressure and hemoglobin during hemodialysis. Chose the best position for doing hemodialysis without development of hypotension and to know which age groups have the best response hemodialysis.*

Method: *The study lasted from first of November /2012 to thirty of July/ 2013. Eighty patients (45 males and 35 females) were included in the study. These patients were suffering from chronic renal failure (CRF) and on regular hemodialysis (HD). Their ages ranged from 21-70 years old and they divided into five age group.This research is based on cross sectional analytical study in order to assess the effect of postural changes on the (BV), (BP) and (Hb)in patients with (CRF) on hemodialysis. This study is conducted at Al-Hussien Teaching Hospital in Thiqar city. The protocol of the study involves a questionnaire about name, age , sex, address(urban or rural),smoking and the causes of CRF.The second part of the protocol of the study involves the measurement of the (BP),(BV) by Doppler study and the measurement of the Hb level on different positions before and after dialysis.*

Results:*The study shows that male gender ,smoking and rural area are important risk factor for CRF .The study shows a significant change in the blood velocity and blood pressure on changing positionbut no significant changes in the level of the Hb before and after hemodialysis .*

Key wards: *Hemodialysis, postural changes, blood velocity.*

I. Introduction

The hemodialysis (HD) is medical procedure that use a special machine (dialysis machine) to filter water products from the blood and to restore its normal constituents . This shuffling of multiple substance is accomplished by virtue of the differences in the rate of their diffusion through semi-permeable membrane. Vascular access is required for hemodialysis. The vascular access that preferred is the arterio-venous fistula (AVF). The other access is a large-bore dual-lumen catheters .It is inserted into the internal jugular or femoral vein. The other type of dialysis is the peritoneal dialysis (PD), in which the patient's blood to a buffered dialysis solution across a semi-permeable membrane. However, the blood remains within the body and the semi-permeable membrane is the peritoneum. Dialysis fluid is introduced by the peritoneal dialysis catheter (**Firth et al. ,2001**). Many patients during dialysis develop hypotension, so this will lead to cessation of the session of hemodialysis . Dialysis hypotension is estimated to occur in 20% of(HD) session,**(Daugirdas ,2001**) . This hypotension can lead to serious vascular complications, such as cerebral infraction cardiac and mesenteric ischemia(**John et al. , 2000 andSchreiber , 2001).** This may contribute to chronic overhydration due to an inability to reach dry weight and may lead to under-dialysis **(Roncoet al. , 2005).**

The main cause of the dialysis hypotension is a decrease in blood volume which results from the imbalance between the ultrafiltration rate and the plasma refilling rate(**Van der Sande et al . , 2000).** Non-invassive devices that continuously monitor relative blood volume (RBV) changes during HD are being advocated as a tool to maintain an adequate volume 0f the intravascular compartment in order to avoid dialysis hypotension (**De Vries&Donker1994and Steueret al. , 1996) .**Randomized studies on the value of relative blood volume measurements in order to prevent dialysis hypotension are lacking. Many observational studies, however, have linked relative blood volume changes during HD with the course of intra –dialytic blood pressure and the occurrence of dialysis hypotension . Only a few of these studies demonstrated a relationship between the RBV and the development of dialysis hypotension **(Kim et al . ,1970; Ruffmann et al . , 1990**). Most studies did not find a close relationship between the RBV course and the development of the dialysis hypotention(**Maeda et al . ,1988, Andrulli et al. , 2002, Tonelli et al., 2002).**

Inagaki and kuroda (2001) have compared dialysis patients and healthy controls with regard to this haemodilution after the change from an erect to a supine position. Interestingly, these authors found that haemodilution and thus the fluid flux from the interstitial tissue to the vascular space took more time (>30 min) in comparison with healthy controls (<15 min)**(Inagaki&Kuroda ,2001**). Many HD patients assume a supine or half-sitting position just before the start of the HD session (e.g. for the connection of a central venous access) after a period of standing. The RBV device uses the first hemoglobin (Hb), hematocrit (Ht) or total protein measurement as the reference value to calculate subsequent RBV changes. Postural changes have a profound effect on plasma volume in healthy subjects(**Lundvall et al. , 1995; Lundvall et al . ,1998**) as well as in HD patients **(Ookawara et al. , 2001**).

Barth et al. tested the hypothesis that HD patients have an individual critical RBV below which dialysis hypotension will occur (**Barth et al. ,2003).**

A study bypostiglious **(**1991)show the changes in middle cerebral artery velocity after dialysis in uremic patient and the result was a decrease in the blood velocity in the middle cerebral artery.

There have been very little research concerning the effect of postural changes on blood velocity, blood pressure and the hemoglobin level in uremic patients on hemodialysis. Therefore, this research is carried out to investigate the effect of postural changes on blood velocity in uremic patient on hemodialysis and in relation with the blood pressure and hemoglobin.

The aim of the study.

1. Assess the effect of changing position on blood velocity, blood pressure and hemoglobin during hemodialysis.
2. Chose the best position for doing hemodialysis without development of hypotension and to know which age groups have the best response hemodialysis.

II. Method

The study lasted from first of November /2012 to thirty of July/ 2013. Eighty patients (45 males and 35 females) were included in the study. These patients were suffering from chronic renal failure (CRF) and on regular hemodialysis (HD). Their ages ranged from 21-70 years old and they divided into five age group as the fallowing .

1. First group (21-30) years (2 male &3 female).
2. Second group (31-40) years (9 male &2 female).
3. Third group (41-50) years (21 male &19 female).
4. Fourth group (51-60) years (10 male &7 female).
5. Fifth group (61-70) years (3 male &4 female).

This research is based on cross sectional analytical study in order to assess the effect of postural changes on the (BV), (BP) and (Hb)in patients with (CRF) on hemodialysis. This study is conducted at Al-Hussien Teaching Hospital in Thiqar city. Some patients were excluded from this study but include acute renal failure, Diabetes mellitus, fistula on cubital fossa and patients with fluid over load.The protocol of the study involves a questionnaire about name, age , sex, address(urban or rural),smoking and the causes of CRF.The second part of the protocol of the study involves the measurement of the (BP),(BV) by Doppler study and the measurement of the Hb level on standing position ,then change the patient's posture to supine position and the (BP)and(BV) were measured. After that, four hours of HD was done. When the HD finished the (BP),(BV) and Hb were measured again. After that, the patients re –stood and the (BP) and (BV) were measured. The Hb was not measured to avoid frequent aspiration of blood from patients.

III. Results

The study shows that male gender ,smoking and rural area are important risk factor for CRF .Hypertension is most common cause of CRF .The study shows a significant increase in the blood velocity from standing position to supine position before and after dialysis in most age groups but the age groups (G5) and (G4) show the highest significant increase. The study also shows a significant increase in the blood pressure from standing position to supine position before dialysis in most age groups but the age groups (G5) and (G4) shows the highest significant decrease. The study shows no significant changes in the level of the Hb before and after hemodialysis and this was explained by the frequent aspiration of blood during dialysis and gastrointestinal bleeding that counter the effect of the use of the erythropoietin for treatment anemia of CRF as shows in the tables below.

Table 1: Changes of blood velocity, blood pressure and Hb according to age and sex at supine position before and after dialysis.

Age groups/Years	Number of patients	Parameters at supine position					
		Before dialysis		After dialysis			M/F
		Mean BV (cm/sec	Mean BP. (mmHg)	Mean BV (cm/sec)	Mean BP. (mmHg)	Mean Hg . g/dl	
G1(21- 30)	5	46.3	93.0	53.7	86.6	9.87	2/3
G2(31-40)	16	47.8	98.5	55.2	94.4	9.84	9/7
G3(41-50)	40	48.5	100.4	56.3	94.7	9.80	21/19
G4(51-60)	12	50.7	103.9	59.4	97.2	9.73	10/2
G5(61-70)	7	49.2	105.0	59.6	100.5	9.76	3/4
Total	80	**M±SD** 48.76±6.48	**M±SD** 100.4±7.42	**M±SD** 56.48±6.12	**M±SD** 94.7±8.13	**M±SD** 9.59±11.92	80

*P value< 0.0001

Table 2: Changes of blood velocity, blood pressure according to age and sex at Re- standing position.

Age groups/Years	Number of patients	Parameters at Re-standing position		
		Mean Blood velocity(cm/sec	Mean BP(mmHg)	M/F
G1(21- 30)	5	41.2	87.4	2/3
G2(31-40)	16	42.1	92.1	9/7
G3(41-50)	40	42.9	93.4	21/19
G4(51-60)	12	43.7	98.2	10/2
G5(61-70)	7	44.6	99.4	3/4
Total	80	**M±SD43.09±4.68**	**M±SD 93.43±6.94**	80

**P value< 0.0001

Table 3: Changes of blood velocity according to age and sex at different position.

Age groups/Years	Number of patients	BV at Standing position	BV at Supine position		BV at Re-Standing position	M/F
			Before dialysis	After dialysis		
G1(21- 30)	5	36.7	46.3	53.7	41.2	2/3
G2(31-40)	16	36.4	47.8	55.2	42.1	9/7
G3(41-50)	40	37.2	48.5	56.3	42.9	21/19
G4(51-60)	12	38.0	50.7	59.4	43.7	10/2
G5(61-70)	7	37.9	49.2	59.6	44.6	3/4
Total	80	**M±SD 37.18±4.96**	**M±SD 48.76±6.48**	**M±SD 56.48±6.12**	**M±SD 43.09±4.68**	80

**P value< 0.0001

Table 4:Changes in blood pressure(BP) according to age and sex at different position.

Age groups/Years	Number of patients	MBP at Standing position	MBP at Supine position		MBP at Re-Standing position	M/F
			Before dialysis	After dialysis		
G1(21- 30)	5	87.8	93.0	86.6	87.4	2/3
G2(31-40)	16	94.8	98.5	94.4	92.1	9/7
G3(41-50)	40	96.1	100.4	94.7	93.4	21/19
G4(51-60)	12	99.3	103.9	97.2	98.2	10/2
G5(61-70)	7	102.2	105.0	100.5	99.4	3/4
Total	80	**M±SD 96.16±8.69**	**M±SD 100.4±7.42**	**M±SD 94.43±8.13**	**M±SD 93.43±6.94**	80

****P value <0.0001**

Table 5: Changes in Hemoglobin (Hb) level according to age and sex at different position

Age groups/Years	Number of patients	Hb at Standing position	Hb at Supine position		Hb at Re-Standing position	M/F
			Before dialysis	After dialysis		
G1(21- 30)	5	9.87	-	9.67	-	2/3
G2(31-40)	16	9.84	-	9.75	-	9/7
G3(41-50)	40	9.80	-	9.59	-	21/19
G4(51-60)	12	9.73	-	9.43	-	10/2
G5(61-70)	7	9.76	-	9.51	-	3/4
Total	80	**M±SD 9.80±11.97**	-	**M±SD 9.59±11.92**		80

P value 0.218

Table 6: Changes in Hemoglobin (HB) level according to age and sex at different position

Age groups/Years	Number of patients	Hb at Standing position	Hb at Supine position		Hb at Re-Standing position	M/F
			Before dialysis	After dialysis		
G1(21- 30)	5	9.87	-	9.67	-	2/3
G2(31-40)	16	9.84	-	9.75	-	9/7
G3(41-50)	40	9.80	-	9.59	-	21/19
G4(51-60)	12	9.73	-	9.43	-	10/2
G5(61-70)	7	9.76	-	9.51	-	3/4
Total	80	**M±SD 9.80±11.97**	-	**M±SD 9.59±11.92**		80

P value 0.218

IV. Discussion

Male gender ,smoking and rural area are important risk factor of CRF. This could mean that the age prevalence of CRF may differ from one population to another and it may be attributed to the nature of CRF in which the signs and symptoms of CRF occur gradually and do not become evident until the disease is far advanced because of the amazing compensatory ability of the kidneys **(Sarnaket al.,5005 and Porth,2007).**

On the otherhand, most of the patients with CRF have a history of hypertension which have along course of progression**.** .A good attention should be directed to investigate this condition and act to prevent it'scomplication.The results show that the prevalence of CRF was significantly higher in male on comparism with female . This high prevalence of CRF in males could be due to thier habits like smoking and alcohol consumption. The factors involved in this gender disparity may include diet ,,kidney size ,differences in the glomerular hemodynamics, and the direct effects of sex hormones. There are some studies which show that the estrogen slow the progression rate of renal diseases. Several studies have evaluated the effect of selective estrogen receptor modulators on the renal function in humans **(Silbiger&Neugarten,2008) .**

The study shows no significant changes in the level of the Hb before and after hemodialysis and this was explained by the frequent aspiration of blood during dialysis and gastrointestinal bleeding that counter the effect of the use of the erythropoietin for treatment anemia of CRF.The study shows significant increase in the blood velocity from standing position to supine position before and after dialysis,and also shows significant increase in the blood velocity from standing position to Re-Standing position and these results were explained by changes on the blood pressure and gravity according to Bernoulli's equation .The study shows that the blood velocity was decreased after change position from supine position before and after dialysis to Re-Standing position, but in spite of this decrease in the velocity on re-standing position the BV remained higher than its level on standing position and before hemodialysis.

The age groups (G5)and(G4) show the highest significant increase in the blood velocity .These results was explained by changes on the blood pressure where these groups (old age) show a decline in the sensitivity of their cardiac β- plasma noradrenaline levels that attempt to compensate for reduced adrenergic responses**,** reduced baroreceptor sensitivity**,**and elevated circulating receptor sensitivity but may blunt the normal response of an increase in noradrenaline release on standing, so that explain the more reduction of mean blood pressure . The study shows a significant increase in the blood pressure from standing position to supine position before dialysis and this explained by autonomic neuropathy. The study shows also shows a significant decrease in the blood pressure from standing and supine position before dialysis to the supine position after dialysis. The age groups (G5)and(G4) show the highest significant decrease in the blood pressure.

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