Nat. Volatiles & Essent. Oils, 2021; 8(5): 5719 - 5723

NVEO
Natural Volatiles & Essential Oils

The Impact of Hemodialysis on the Blood Velocity, Blood Pressure and Hemoglobin in Patients with Chronic Renal Failure

Abdul-Hassan Mahdi Salih[1], Saad Mashkoor Waleed[2], Abdul - Aziz Ahmed Aziz[3], Yasmeen Ali Hussien[4]

[1]Department of Physiology, College of Medicine, University of Thiqar, Iraq,
Email: abdalhassan-m@utq.edu.iq
[2]Department of Pharmacology, College of Pharmacy, University of Al kafeel, Iraq, Email: Saad.alzaiy@alkafeel.edu.iq

[3]Department of Physiology, College of Medicine, University of Telafer, Iraq, Email: abahaz1957@yahoo.com
Department of Pharmacology, College of Pharmacy, University of Al kafeel, Iraq, Email: Yasmeen.alamri@alkafeel.edu,iq
***Correspondent author,** Saad Mashkoor Waleed, Email: Saad.alzaiy@alkafeel.edu.iq*

Abstract

Background: Chronic kidney disease characterized by abnormal function and structure of the kidney which is occurs for more than three months with decrease in the glomerular filtration rate less than 60ml/min/1.73 m2 and Albuminuria when the patients reach to state of end stage renal failure ,replacement therapy should be started, therefore, most of these patients require a special procedure Hemodialysis (HD), which is done by having a special device, a hemodialysis machine, and acts as a filter for aqueous products to form blood with natural components. In 20% of HD sessions, a drop in blood pressure may occur due to dialysis. **Objective:** To measure the impact of HD on blood velocity (BV), blood pressure (BP). **Method***:* A cross-sectional study was adopted to assess the effect of HD on Blood volume and blood pressure level among patients with chronic kidney disease. The study was conducted at Al-Hussein Teaching Hospital in DhiQar for the period from December 1, 2019 to July 30, 2020 with the participation of 90 patients (50 males and 40 females). They were diagnosed as having chronic kidney disease (CKD) and taking regular treatment in addition to dialysis. The patients were divided into five age groups and their ages ranged between 21-70 years. The study protocol includes measuring blood pressure with a sphygmomanometer and BV by Doppler study before and after dialysis. **Results:** This study shows a significant change in BV and BP before and after HD. **Conclusion:** hypotension during hemodialysis seems to be common among patients with ESRD maintained on hemodialysis, thus adequate monitoring of BP during dialysis process is essential to avoid any complication ,so it is important to know at which hour of the dialysis the hypotension occurred to make dialysis profile by changing the level of electrolyte on the dialysis set and change the speed of hemofiltration .from the study male gender are more liable to developed CKD so it is important to make fallow up for male with high risk factor for chronic kidney disease especially those with history of diabetes and hypertension .

Keywords: Hemodialysis, blood pressure, blood velocity.

Introduction

Chronic kidney disease (CKD) is common problem and most of patients need replacement therapy for as life saving measures especially when the patients develop end stage renal failure ,one of these measures is hemodialysis but one of the important complications of this procedure is decrease in the blood pressure that occurs during the time of the procedure whether at the starting of dialysis or at the last hour of dialysis and this decrease in the blood pressure called dialysis- induced hypotension (DIH) that occurs in (20 %-30%) of cases of hemodialysis (1-3), so special attention should be taken for these patients on the frequents sessions because this hypotension my lead to many complication like ischemic heart disease, cerebrovascular accident and mesenteric ischemia (4-5), so if the patients develop sever hypotension the hemodialysis should be stopped and that may lead to inefficient dialysis (6-9). Decreased blood volume caused by increased ultra filtration rate and decreased plasma refill rate is the main cause of low blood pressure caused by dialysis (8-10) but the hypotension during dialysis can be result from lack of vasoconstriction or due to cardiac diseases (11-12) or can be result from occult hemorrhage ,septicemia ,dialysis reaction and air embolism. Many mechanisms for the heart and vascular system to response for dialysis induced hypotension include reduction of the venous capacity and increase arterial tone and the rate and contractility of the heart. Other method of dialysis called peritoneal dialysis in which there is less risk of developing dialysis hypotension in which there is special catheter where used that called PD catheter (13-15). The dialysis induced hypotension can be presented as acute episode which is develop suddenly as drop in the systolic blood pressure below 90 mmHg or at

least 20mmHg associated with clinical manifestation or can be presented as recurrent attack of hypotension or presented as chronic persistent hypotension (16). The blood velocity represent the blood speed in the aorta or the rate of blood position alteration in the body .Many factors effects the flow of the blood such as blood pressure and volume , blood viscosity, and aortic wall dissipation .Doppler ultrasound is used for measurements of blood flow rate. Investigates appears connections between the event of dialysis, hypotension change within the blood volume and that happens amid HD (17). There is no close relationship between the course of RBV and low blood pressure during hemodialysis according to the opinion of some researchers (18-20). A few studies shown that there were changes within the velocity of the middle cerebral artery after dialysis and there was a decrease in BV within the middle cerebral artery within the urine patient (20-22). There are few considers on the impact of HD on BV and BP level in uremic patients on support HD. In this manner, this study will be carried out to find the impact of HD on blood volume and blood pressure in a bulimic patient (23-24).

Subject, Material and Method

A study was adopted to evaluate the consequence of HD on Blood volume and blood pressure level among patients with CKD. The study was conducted at Al-Hussein Teaching Hospital in DhiQar. For the period from December 1, 2019 to July 30, 2020.With the participation of 90 patients (50 males and 40 females).Participant divided as the following:

- 1^{St} group (21-30) years (three male and four female)
- 2^{nd} group (31-40) years (ten male and three female)
- 3^{rd} group (41-50) years (twenty two male and twenty female)
- 4^{th} group (51-60) years (eleven male and eight female)
- 5^{th} group (61-70) years (four male and five female)

A cross-sectional study was assumed to evaluate the consequence of HD on Blood volume and blood pressure level among patients with CKD, which conducted at Al-Hussein Teaching Hospital in DhiQarcity, Iraq. The blood pressure was measured by mercury sphygmomanometer by considering the korotkoff sound auscultator method for measuring BP where the diastolic BP diagnosed at the highest value while the diastolic BP at the point where the sound disappeared. The BV was examined by using Doppler ultrasound (Siemens acuson x 300, Germany where the probe of Doppler ultrasound was moved over the cubital fossa for brachial artery localization. The study protocol includes estimation of BP, BV by Doppler before HD and four hours after HD with the exclusion of some patients from this study, such as acute renal failure and patients with fluid overload and patients with fistula on the cubital fossa and diabetes.

Results

The study shows a significant increase in the BV after dialysis in most age groups. The study shows a significant decrease in the BP after HD mainly in groups four and five with P value< 0.0001as shown in the table (1) where hypotension develop in 27.7% 25 patients mainly in group four and five as shown in the figure (3). Male gender is important risk factors of CRF as shown in the figure (1) with 55.5% (50 patients) while the female represent 44.5% (40 patients) especially in age group 2(31-40) years. The study shows a highly significant statistical association in increasing of the prevalence of CRF among age group 3(41-50years) with 46.6% as shown in the figure (2).

Table 1: Changes of blood volume and blood pressure relation to age and sex before and after dialysis

Age Groups/Year	Number of Patients	Parameters				
		Before dialysis		After dialysis		M/F
		Mean BV (cm/sec)	Mean BP (mmHg)	Mean BV (cm/sec)	Mean BP (mmHg)	
G1(21-30)	7	45.6	92.4	51.5	83.1	3/4
G2(31-40)	18	42.5	97.1	53.7	97.2	10/8
G3(41-50)	42	43.8	100.6	55.7	93.1	22/20
G4(51-60)	14	51.2	106.1	58.2	96.1	11/3

G5(61-70)	9	48.6	104.8	55.9	100.8	4/5
Total M ± SD	90	48.76 ± 6.84	100.4 ± 7.42	56.48 ± 6.12	94.7 ± 8.13	90

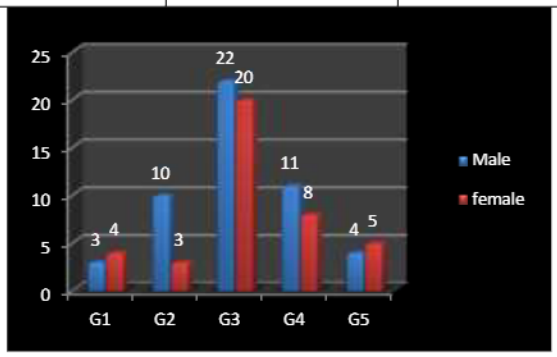

Figure 1: Distribution of CKD according to gender

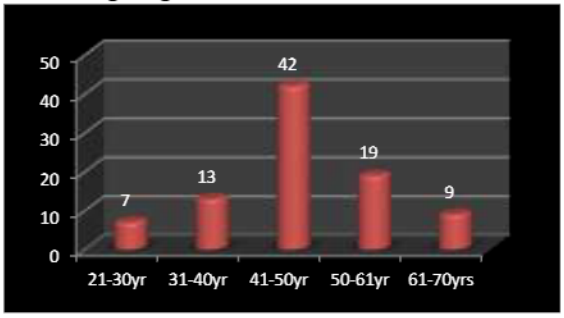

Figure 2: Distribution of CKD according to age

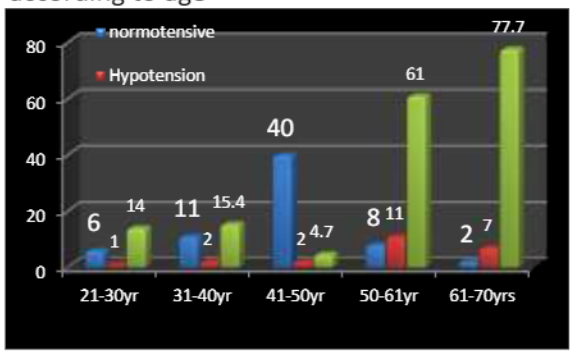

Figure 3: Distribution of dialysis induced hypotension according to age

Discussion

The effects of increase age and gender in development and progression of different diseases and specially the kidney disease considered as one main topics in many studies. The study shows that the prevalence of ESRD was more common in males than females 55.5% versus 44.5%. Females usually tend to have less chance to develop end stage renal disease especially during reproductive period, but unfortunately tend to have high chance of developing high incidence rate than males after menopause. The result of this study was goes with the report of the Japanese Society for Dialysis Therapy, which showed a low incidence of ESRD among women in comparison with male (25-27). Many factors may be responsible for the difference which consist of genetic causes, environmental causes, life style, female hormones physiological effects (28-30). The results show that majority of patients with ESRD are middle and elder age groups, these finding consider as logical dinging because aging kidney always already had a reduced glomerular filtration rate (31-32).The result of the NationalHealth and Nutrition Examination Survey 1999-2004 (NHANES), revealedthat about one third of peoples aged 70 or more have some degree ofimpaired renal function depending on estimated glomerular filtration rate 37.38Despite great variation in definition of intradialytic hypotension, the result of the present study demonstrated that the majority of patients with ESRD included in this study manifested a drop in BP with significant difference in the mean of BP before and after hemodialysis (P value< 0.0001). In fact, there are more than one explanation for this phenomenon during hemodialysis, a decrease in blood volume, sudden

change in body fluid osmolality and electrolyte composition together with improper vascular tone and inadequate neural response are among the main contributing factors. These factors tend to be more complicated with already existing cardiovascular morbidity (32-33). The result of study showed a significant increase in brachial artery blood flow velocity after dialysis, in fact blood flow velocity have been utilized as an index of arteriovenous fistula patency and proper functioning and a low flow rate has been considered as an indication for arteriovenous fistula repair (34-35).

conclusion and recommendations

hypotension during hemodialysis seems to be common among patients with ESRD maintained on hemodialysis, thus adequate monitoring of BP during dialysis process is essential to avoid any complication, so it is important to know at which hour of the dialysis the hypotension occurred to make dialysis profile by changing the level of electrolyte on the dialysis set and change the speed of hemofiltration. From the study male gender are more liable to develop CKD so it is important to make follow up for male with high risk factor for chronic kidney disease especially those with history of diabetes and hypertension

References

(1) Mostafa Abdel-Fattah El-Ballat, Mohamed Ahmed El-Sayed, Hossam Kamel Abdel-Raouf Emma. Epidemiology of End Stage Renal Disease Patients on Regular Hemodialysis in El-Beheira Governorate, Egypt. The Egyptian Journal of Hospital Medicine 2019; 76 (3): 3618-3625.

(2) GBD Chronic Kidney Disease Collaboration. Global, regional, and national burden of chronic kidney disease, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2020; 395: 709–733.

(3) Lee H, Manns B, Taub K, et al: Cost analysis of ongoing care of patients with end-stage renal disease: The impact of dialysis modality and dialysis access. Am J Kidney Dis. 2002; 40:611–622.

(4) Zelmer JL. The economic burden of end-stage renal disease in Canada. Kidney International, 2007; 72(9): 1122-1129.

(5) Giuseppe Turchetti, S Bellelli, M. Amato, et al. The social cost of chronic kidney disease in Italy. The European Journal of Health Economics, 2017; 18: 847–858.

(6) Bernard Canaud, Allan Collins, Frank Maddux. The renal replacement therapy landscape in 2030: reducing the global cardiovascular burden in dialysis patients. Nephrology Dialysis Transplantation, 2020;35(SUPPL 2): ii51–ii57.

(7) Hussien, Yasmeen A., et al. The Nephroprotective Effect of Lycopene on Renal Ischemic Reperfusion Injury: A Mouse Model. Indian Journal of Clinical Biochemistry 35.4 (2020): 474-481.

(8) Cameron JI, Whiteside C, Katz J, et al: Differences in quality of life across renal replacement therapies: A meta-analytic comparison. Am J Kidney Dis, 2000; 35:629–637.

(9) Tanna MM, Vonesh EF, Korbet SM: Patient survival among incident peritoneal dialysis and hemodialysis patients in an urban setting. Am J Kidney Dis, 2002; 36:1175–1182.

(10) Heaf JG, Lokkegaard H, Madsen M: Initial survival advantage of peritoneal dialysis relative to haemodialysis. Nephrol Dial Transplant, 2002; 17:112–117.

(11) Collins AJ, Weinhandl E, Snyder JJ, et al: Comparison and survival of hemodialysis and peritoneal dialysis in the elderly. Semin Dial, 2002; 15:98–102.

(12) Sands JJ, Usvyat LA, Sullivan T, et al. Intradialytic hypotension: frequency, sources of variation and correlation with clinical outcome. Hemodial Int. 2014; 18(2):415–422.

(13) Sars B. van der Sande F.M. Kooman J.P. Intradialytic Hypotension: Mechanisms and Outcome. Blood Purif 2020; 49:158–167.

(14) Flythe JE, Xue H, Lynch KE, et al. Association of mortality risk with various definitions of intradialytic hypotension. J Am SocNephrol. 2015;26(3):724–734.

(15) Assimon MM, Flythe JE. Definitions of intradialytic hypotension. Semin Dial. 2017; 30(6):464–472.

(16) Rocha A, Sousa C, Teles P et al. Effect of dialysis day on intradialytic hypotension risk. Kidney Blood Press Res 2016; 41: 168–174.

(17) Yu J, Liu Z, Shen B, et al. Intradialytic hypotension as an independent risk factor for long-term mortality in maintaining hemodialysis patients: a 5-year follow-up cohort study. Blood Purif 2018; 45: 320–326.

(18) Kuipers J, Verboom LM, Ipema KJR, et al. The prevalence of intradialytic hypotension in patients on conventional hemodialysis: a systematic review with meta-analysis. Am J Nephrol 2019; 49: 497–506.
(19) Kanbay M, Ertuglu LA, Afsar B, et al. An update review of intradialytic hypotension: concept, risk factors, clinical implications and management. Clinical Kidney Journal, 2020; 13(6): 981–993.
(20) Shoji T, Tsubakihara Y, Fujii M, et al. Hemodialysis-associated hypotension as an independent risk factor for two-year mortality in hemodialysis patients. Kidney Int. 2004; 66(3):1212–1220.
(21) Kuipers J, Verboom LM, Ipema KJ, et al.Abdul Hassan Mahdi, The prevalence of intradialytic hypotension in patients on conventional hemodialysis: A systematic review with meta-analysis. Am J Nephrol. 2019; 49(6): 497– 506.
(22) Burton JO, Jefferies HJ, Selby NM, et al. Hemodialysis-induced cardiac injury: determinants and associated outcomes. Clin J Am SocNephrol. 2009; 4(5):914–920.
(23) Mac Ewen C, Sutherland S, Daly J, et al. Relationship between hypotension and cerebral ischemia during hemodialysis. J Am SocNephrol. 2017; 28(8):2511–2520.
(24) Seong EY, Zheng Y, Winkel Mayer WC, et al. The relationship between intradialytic hypotension and hospitalized mesenteric ischemia: A case- control study. Clin J Am SocNephrol. 2018; 13(10):1517–1525.
(25) Iseki K. Gender differences in chronic kidney disease. Kidney International, 2008; 74: 415–417.
(26) Elliot SJ, Karl M, Berho M, et al. Estrogen deficiency accelerates progression of glomerulosclerosis in susceptible mice. Am J Pathol. 2003; 162(5): 1441-1448.
(27) Silbiger S, Neugarten. Gender and human, chronic renal disease. Gender medicine, 2008; 5(supp1): s3-s10.
(28) Cobo G, Hecking M, Port FK, et al. Sex and gender differences in chronic kidney disease: progression to end-stage renal disease and haemodialysis. Clin Sci (Lond). 2016; 130 (14): 1147– 1163.
(29) Eriksen BO, Ingebretsen OC. The progression of chronic kidney disease: a 10-year population-based study of the effects of gender and age. Kidney Int. 2006; 69(2):375–382.
(30) Coresh J, Selvin E, Stevens LA. Prevalence of chronic kidney disease in the United States. JAMA, 2007; 298(17): 2038- 2047.
(31) Dinesh K, Kunaparaju S, Cape K, et al. A model of systolic blood pressure during the course of dialysis and clinical factors associated with various blood pressure behaviors. Am J Kidney Dis. 2011; 58(5):794–40
(32) van der Sande FM, Dekker MJ, Leunissen KM, et al. Novel insights into the pathogenesis and prevention of intradialytic hypotension. Blood Purif. 2018; 45(1-3):230–235.
(33) Sars B, van der Sande FM, Kooman JP. Intradialytic Hypotension: Mechanisms and Outcome. Blood Purif, 2020; 49:158–167.
(34) Ohira S, Naito H, Amano I, et al. 2005 Japanese Society for Dialysis Therapy guidelines for vascular access construction and repair for chronic hemodialysis. Ther Apher Dial. 2006; 10:449-462.
(35) Ogawa T, Matsumura O, Matsuda A, et al. Brachial Artery Blood Flow Measurement: A Simple and Noninvasive Method to Evaluate the Need for Arteriovenous Fistula Repair. Dialysis & Transplantation 2011; 40(5): 2