Evaluation of various physiological parameters affecting the outcomes in patients underwent dialysis procedure

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Abstract

The kidney plays a vital role in homeostatic function by regulating the salts/water balance in the body. Renal function is compromised due to various factors internal and external conditions such as diabetic nephropathy (8.3%), hypertension (HTN) (42.2%), diabetes and hypertension (22.9%), drugs, age, and immune-related. Dialysis is the only option for end-stage renal disease (ESRD) beside kidney transplantation. This retrospective study was based on the collection of data from the profiles of patients undergoing dialysis in order to find the variations in physiological parameters such as; hemoglobin (Hb), bilirubin, serum creatinine, urea level, and blood pressure(B.P) both pre- and post-dialysis. Patients had concomitant diseases; hepatitis B virus (8.3%), hepatitis C virus (42.2%), diabetes mellitus (29.4%) and HTN (78.9%). Blood pressure was higher than the standard about 6-9mmHg systolic pre-dialysis and 10mm Hg post-dialysis. Whereas, the diastolic B.P was lower about 5mmHg pre-dialysis while it was up to the standards after dialysis. The Hb levels were within range showing the minor variation of about 0.2-0.3g/dL. Serum creatinine levels were higher 7.1985±3.26930 to7.9761±2.46952 and BUN was also higher than normal with the mean difference of about 0.2-5mg/dL. In conclusion, the blood pressure, hemoglobin, serum creatinine and blood urea nitrogen decreases which were raised earlier to dialysis. The weight of patient also decreased after dialysis. However increased in body weight have been observed in patients with kidney disease accompanied with diabetes. These parameters must be properly controlled to improve the health outcomes.

Keywords: Pre-dialysis, Post-dialysis, Hypertension, Diabetes Mellitus, Nephropathy.

Introduction

The kidney maintains water and salt balance through urine formation by filtering the blood in nephrons in cortical as well as medullary part of the kidneys and thus helps in maintaining the homeostatic function of the body. Our kidney receives approximately 22% of the total blood from cardiac output which is supplied to the renal system by the help of renal arteries.[1] It plays vital regulatory roles in the body like: excretion of drugs, chemicals and waste product, electrolyte/water balance in the body, osmolarity, arterial pressure, hormones production, secretion and excretion, regulatory function of red blood cells (RBCs) production and gluconeogenesis.[2-4] Glomerulus filtration rate (GFR) is an important determinant of kidney function and can be determined by various methods like creatinine clearance.[5-7] Creatinine clearance is the method to measure the GFR level; however, it is a lengthy process requiring multiple serums sampling to be collected for 24 hours. Serum Creatinine is used to measure the GFR level but has some drawbacks as it varies with the age, gender, race, and level of GFR.[8] Decreased GFR level may lead to reducing renal function can results in hypertension (HTN), heart failure,[9] health-related quality of life and increase mortality rate in renal patients.[10] In order to avoid the complications of the lower GFR level various pre end-stage renal disease care factors such as blood pressure, diet modification, proteinurea, Angiotensin-converting enzyme inhibitors (ACE), avoiding nephrotoxicity and proper glycemic control are employed.[11]

General criteria for the induction of dialysis is according to the National Kidney Foundation Dialysis Outcomes Quality Initiatives (NKF-DOQI) suggested the dialysis indication at GFR less than 10.5ml/min while SCr 9-14 ml/min.[12] Patients undergoing dialysis undergo various complications due to change in the physiological parameters such as anemia, blood urea nitrogen (BUN) albumin level[13] glycemic and lipid profiling affecting the compliance, quality of life as well as the mortality rate.[14] This study aimed at to study the physiological parameters changed during the process of dialysis in the patients like hemoglobin, blood glucose level, and serum creatinine, and bilirubin, blood urea nitrogen level at pre and post intervals of dialysis of each session.

Materials and Methods

A retrospective study was conducted at Lahore Government Hospital (LGH), Lahore, which has the capacity of 26 patients to be dialyzed per day, from July to September 2015. Data were collected by using the performa containing the information on A) Demographics (name, age gender, ethnicity, marital status, education level, occupation, address, and socio-economic status), B) Lab values (pre-post-dialysis indications like haemoglobin (Hb), serum creatinine (SCr), Bilirubin, weight, Blood Urea Nitrogen (BUN) etc. C) Drug's side effects (urine color, stool color,

jaundice, itching problem, skin tone, anorexia, joint pain). D) co-morbidities (blood pressure, cardiovascular system (CVS) disorders, hepatitis, neurological disorders, anemia, fatigue or other chronic diseases) related to dialysis treatment. Data from the patient file was collected and analyzed by using SPSS software.

A questionnaire based on socio-demographics, disease history, medication, dialysis process and related lab values to study the desired parameters. The results are then analyzed by using SPSS software version 21 and student t-test was applied to determine the p-value and confidence interval of 95%.

Study Design: It is a retrospective study design to evaluate the variation in the physiological parameters in the patients with particular intervals of his/her treatment. The approval of study was taken from ethical committee of Department of Clinical Pharmacy, Punjab University College of Pharmacy, University of the Punjab, Lahore reference number (ECCR/UCP/04/2015) and hospital committee of ethics on human research Lahore Government Hospital authority.

Inclusion Criteria: Following was the inclusion criteria; Patients undergoing dialysis before 2015, their physiological findings were noted from files and variations were recorded regardless of the age of patients.

Exclusion Criteria: Following was the exclusion criteria; Patients enrolled for dialysis treatment after 2015 at LGH Lahore.

Sample Size: A total of 109 patients were included in this study. Out of 109 patients, 68 males and 41 were females.

Results

We found the mean age of the patients was 41.85±13.28 years and of total 104 about 62.4% and 37.6% were males and females respectively. Majority of the patients 80.7% belong to urban areas and 19.3% were from rural areas. Patients were having blood groups A+ (5.5%), AB+(7.3%),B+(19.3%), B- (0.9%), O+ (13.8%) while the data of blood groups of 53.8% was not available due to the poor socioeconomic background of patients and hospital resource. Patients diagnosed with the renal disease were categorized related to the cause of their disease such as diabetic nephropathy 8.3%, HTN induced 42.2%, diabetes and HTN induced 22.9% whereas other cause including related to drug-induced, age-related chronic kidney disease and immune-related cause while data of 13.8% was not available. These patients were also had co-morbidities such as hepatitis B virus (8.3%), hepatitis C virus (42.2%), diabetes mellitus (DM)(29.4%) and 78.9% have HTN which is the hallmark factor in causing End Stage Renal Disease in these patients along with Diabetes mellitus. Patients with DM were 32 among these 8 were having diabetic nephropathy making about 28.13% of these patients. (Table 1)

Table 1: Socio-demographics and disease history of patients underwent dialysis

Parameters	Total (N)	Mean % age
Age	104	41.85±13.28
Gender		
Male	68	62.4%
Female	41	37.6%
Address		
Rural	21	19.3%
Urban	88	80.7%
Blood group		
A+	6	5.5%
AB+	8	7.3%
B-	1	0.9%
B+	21	19.3%
0+	15	13.8%
Data Not Available	58	53.2%
HBV (+)	9	8.3%
HCV (+)	46	42.2%
HTN	86	78.9%
Diabetes Mellitus	32	29.4%
Diagnosis		
Diabetic nephropathy	9	8.3%
HTN induced Kidney Failure	46	42.2%
HTN and DM induced Kidney Failure	25	22.9%
Others	14	12.8%
Data Not Available	15	13.8%

The laboratory values or parameters pre- and post-dialysis which were related to the renal function to know the adequacy of the dialysis were evaluated every time when dialysis was done at the start, 3rd, 6th, 9th and 12th month. Hemoglobin (Hb) was 8.358±7.27186 g/dL at the start as the base value while it was 8.125±1.64007 g/dL at the end of 12thmonth fluctuating about 0.4 g/dL in this duration. Bilirubin level which is the end product of hemoglobin was 1.333 mg/dL±1.58650 at the base level and it was reduced to 0.73 mg/dL±0.089 at 12th month. Blood sugar level had a mean value of 110.6727 mg/dL±27.62785 as a base value and reduces to 98.2364mg/dL±20.94522 at 12th month. Serum creatinine level which is mostly used to assess the renal function was 7.3343mg/dL±3.24554 as the baseline and it varies as 7.6075mg/dL±2.39553 (3rd month), 7.1985mg/dL±3.26930 (6th month) and 7.9761mg/dL±2.46952 at (12th month). Blood urea level was 102.75mg/dL±39.67 at the start of the dialysis and 107.64mg/dL±44.20 (3rd month), 104.03mg/dL±36.38 (6th month), 103.08mg/dL±31.65 (9th month), and 102.08mg/dL±30.48 (12th month) (Table 2).

The weight of the patient was taken into account before and after dialysis and it was 62.0833kg±16.50081 as the base mean value pre-dialysis while 61.34kg±14.961 was post dialysis mean value. Weight shows variation (reduction) in every dialysis and was 62.8556kg±15.48527 pre-dialysis and 61.1628kg±15.67665 after dialysis at the 9th month. Blood pressure was also measured pre and post dialysis condition. Systolic B.P was 149.5638mm Hg±26.27872 (pre-dialysis) as a base value while 144.7447mm Hg±23.07395 (post-dialysis) of this base value. And at the 9th month, it was lowered from 148.3404mm Hg±25.66138 (pre-dialysis) to 141.4149mm Hg±21.88258 (post-dialysis). Diastolic B.P was 82.8298mm Hg±17.71801 (pre-dialysis) at the start of dialysis as a base value while it decreases to 79.4468mm Hg±13.57703 (post-dialysis) of this base value. It was decreased from 84.0638mm Hg±14.60653 pre-dialysis 80.9681mm Hg±15.66480 post-dialysis of the 9th month. Pulse rate was noted to be 81.4176±9.42581 mean at pre-dialysis 81.5333±6.82230 mean at post dialysis as a base value at 1st dialysis 81.3846±16.06084 (pre-dialysis) and it decreases79.7889±14.97075 (post-dialysis) at the 9th months (Fig. 1 and Fig. 2).

Table 2: Variation in parameters related to dialysis and renal function of patients undergoing dialysis

Parameter	Base line	3rd month	6th month	9th month	12th month
Hb (g/dL)	8.358±7.27186	7.994±1.57892	8.103±2.42074	8.036±1.79924	8.125±1.64007
Bilirubin (mg/dL)	1.333±1.58650	1.0833±1.11342	0.88±0.52600	0.67±0.10700	0.73±0.089
Blood Sugar Level (mg/dL)	110.67±27.62785	115.51±28.47668	108.03±22.04874	101.47±21.52247	98.24±20.94522
Serum Creatinine (mg/dL)	7.3343±3.24554	7.6075±2.39553	7.1985±3.26930	7.7881±3.03258	7.9761±2.46952
Urea level (mg/dL)	102.75±39.67000	107.64±44.20000	104.03±36.38000	103.08±31.65000	102.08±30.48
Weight pre-Dialysis (kg)	62.0833±16.50081	61.2389±17.65926	60.5056±18.84703	61.3389±18.17129	62.8556±15.48527
Weight post dialysis (kg)	61.341±4.96100	58.7885±17.32810	59.9615±16.59991	61.24±15.61100	61.1628±15.67665
Systolic B.P pre-dialysis of each session (mmHg)	149.5638±26.27872	146.4043±20.97275	149.1383±23.21410	148.3404±25.66138	-
Systolic B.P post dialysis of each session (mmHg)	144.7447±23.07395	141.4468±19.76943	140.8830±18.53788	141.4149±21.88258	-
Diastolic B.P pre dialysis of each session (mmHg)	82.8298±17.71801	82.1915±12.81152	85.6809±13.85114	84.0638±14.60653	-
Diastolic B.P post dialysis of each session (mmHg)	79.4468±13.57703	78.7340±11.15692	81.5106±11.33436	80.9681±15.66480	-
Pulse rate pre dialysis of each session(no./min)	81.4176±9.42581	80.8132±17.57392	81.3297±15.31452	81.3846±16.06084	-
Pulse rate after dialysis of each session (no./min)	81.5333±6.82230	78.9667±16.71671	80.8111±13.88386	79.7889±14.97075	-

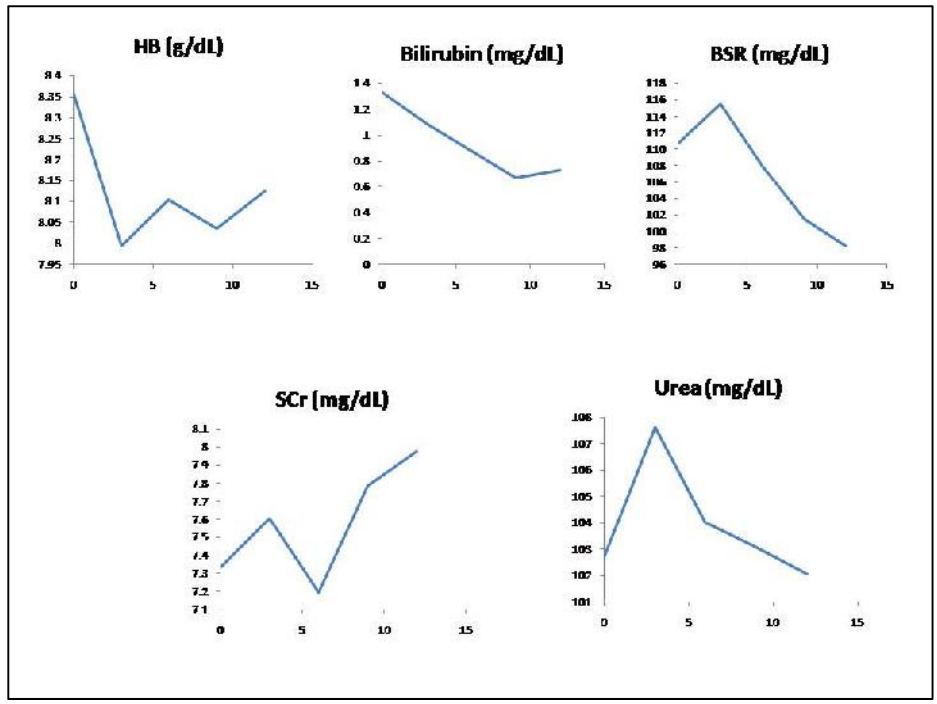

Fig. 1: Variation of Physiological Parameters in dialyzed patients

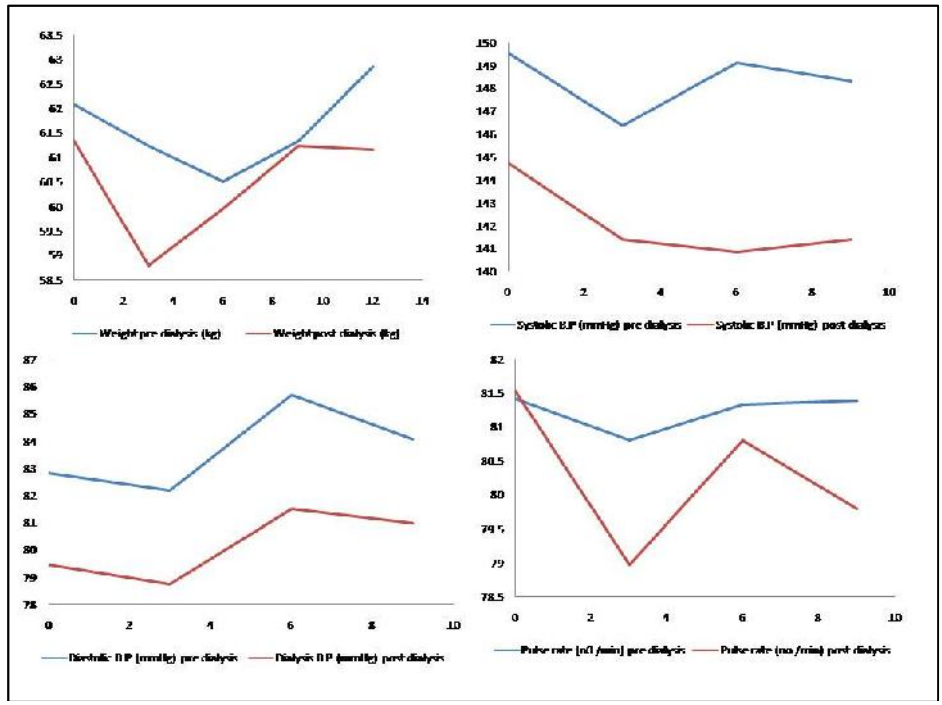

Fig. 2: Variation in physiological parameter pre and post dialysis

Discussion

This retrospective study was based on the patients undergoing dialysis. Patients were diagnosed with hypertension-induced renal failure as well as diabetic nephropathy or both. These were the major risk factors in compromising the renal function leading to renal failure. Majority of the patients belonged to these two categories as HTN and DM are involved in vascular changes of renal capillaries leading to reduce blood circulation.[15] This reduction in blood circulation to glomerulus of the kidney results in lowering of GFR level. Diabetes mellitus another major factor which contributes to renal failure by causing micro-vascular complications due to an uncontrolled glycemic level leading to nephropathy. Diabetic nephropathy causes

thickening of the renal vessels and also disturbing the vasoactive amines level like Angiotensin and endothelin-1 level which are the vasoconstrictors.[16,17] Hence, the hyperglycemia must be controlled in order to prevent the renal pathology which can be predicted by proteinurea.[18] This proteinurea if persistently present can lead to renal failure requiring dialysis.[19] If both are present they may increase the risk of developing it synergistically as they are present in our study and they must be controlled to reduce the risks.[20] Patients undergoing dialysis were reported to be infected with hepatitis C and B as dialysis environment and other related conditions are more liable to spreading of these viral infections. Not only the environmental but transfusions can also be a major factor contributing to the transmission these viruses so the strict measure must be taken to prevent it.[21] Hemoglobin level must be within the normal range of about 11 to 12g/dL and in our enrolled patients its means value is about 7.99-8.35 g/dL at different intervals. Variability in the Hb level is important in compliance during dialysis as greater variation can lead to higher mortality rate.[22] This study suggesting the minor variation of about 0.2-0.3g/dL, however, the use of humectants increase the Hb level during dialysis suggested to improves the quality of life, and physical exertion during exercise.[23] But the higher level of Hb may be a factor leading to cardio-vascular problems in hemodialysis patients.[24] Renal failure is associated with edematous conditions due to water retention in extracellular spaces. To handle edema, hypertonic solution of glucose is used which can lead to Hyperglycemia. This hyperglycemia may further compromise the renal function as well as can lead to coma and death if not properly controlled.[25] However, in our study, the glycemic level of most of the patients was under controlled having mean values within the range. Creatinine level is an important parameter to measure the health status and mortality risk in end stage-renal disease (ESRD) patients during dialysis. Mean serum creatinine level was about 7.1985±3.26930 to7.9761±2.46952 in enrolled subjects which is much higher than normal value. This marker does not only suggest the progression of the renal disease but also used to decide when to initiate the dialysis.[26] In addition to serum creatinine level, another parameter used to measure the health status and adequacy of the dialysis is urea level or blood urea nitrogen (BUN) level. This parameter was higher in this study with the mean difference of about 0.2-5mg/dL. As the BUN level is higher in patients require dialysis so the reduction in this parameter is the goal of the dialysis in order to improve the renal function and to reduce the complication and mortality related to uremia.[13] This reduction is associated with the period of dialysis, urea level and its distribution volume. Variation in weight of patients is used as a parameter of body fluids during dialysis in order to reduce the complication related to CVS and removal of fluids.[27] This study also shows an inter-dialytic reduction in weight 0.9-3.0kg of mean and thus helping in the fluid removal. However, the reverse of this situation, increase in body weight during dialysis decrease the survival in diabetic ESRD patients undergoing hemodialysis. The exact mechanism for this poor survival is unclear yet, but the factors like HTN, CVS complications, and poor glycemic control might be responsible for poor compliance to dialysis.[28] Hemodynamic changes during dialysis is associated with various cardiovascular problems including HTN, hypotension, left ventricular hypertrophy and reduction in arterial distension leading to increasing mortality rate. It is the hypotension which occurred mostly during dialysis and to reduce the mortality risk United kingdom Renal Association standards committee recommends 140/90 mmHg B.P pre-dialysis and 130/80mmHg post-dialysis.[29] Findings of this study are a bit higher than these standard values having mean values of 6-9 mmHg systolic pre-dialysis and about 10mmHg post-dialysis respectively. Whereas the diastolic B.P was lower about 5mmHg pre-dialysis while it was almost up to the standards after dialysis. Hence it is under controlled as hemodialysis is related to the post-dialytic hypotension.[30] Besides hypotension, in order to control the B.P during dialysis anti-hypertensive may also be considered as dialysis is also linked to the hypertension. Thus controlling the B.P either hypo- or hypertension decreases the morbidity, mortality rate as well as increase the compliance to the dialysis. Pulse rate or heart rate is correlated with the mortality rate independently in the patients undergoing dialysis. Dialysis is related to the lower HR in renal failure patients during dialysis mediated by Autonomic nervous system (ANS). Our results show the insignificant difference of pulse rate pre and post dialysis. Lastly it can be summarized that compliance rate, adequacy of dialysis, health outcomes can be improved in a much better way if all these above mentioned parameters are properly regulated.

Conclusion

It is concluded that after dialysis various physiological parameters were affected. Hemoglobin, serum creatinine and blood urea nitrogen decreases which were raised earlier to dialysis. The weight of patient also decreased after dialysis. However increased in body weight have been observed in patients with kidney disease accompanied with diabetes. Blood pressure of the patient also decreases to a certain value. Health-related outcomes during dialysis can be improved in a much better way if all the aforementioned parameters are properly regulated.

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