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The relationship between blood pressure and dialysis adequacy in dialysis patients

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Abstract

Aims: Dialysis inadequacy is one of the determining factors of the morbidity and mortality rate among dialysis patients. Enhancing the adequacy of dialysis is highly effective to improve prognosis of these patients. Several factors have been found to be effective on dialysis adequacy.In this line, the present study aimed at investigating the relationship between blood pressure and dialysis adequacy.

Methods: This cross-sectional study was carried out on 100 patients admitted to hemodialysis unit of Besat (IRIAF) and Baqiyatallah Hospitals in 2010, selected through census sampling. A researched-made questionnaire was used to collect demographic and blood pressure related information from patient's records. Kt/V formula was applied to assess the adequacy of hemodialysis; the URR index was also measured. Data were analyzed by descriptive analytical tests using$SPSS_{16}$ statistical software.

Results: The mean age of participants was 62.21±13.7 years. The mean Kt/V and URR was 1.23±0.38 and 14±11.04 respectively. There was no significant difference between blood pressure and the indices of dialysis adequacy, Kt/V and URR, in hemodialysis patients.

Conclusion: No linear correlation has been found between blood pressure and the indices of dialysis adequacy, Kt/V and URR, in the present study; in this regard, more comprehensive researches with larger sample size are required.

Keywords: Blood pressure; Dialysis adequacy; Hemodialysis

Introduction

Hemodialysis is one of the most important methods of treatment in patients with acute and chronic kidney failure. Removal of the excess materials and maintaining the stability of the body's internal environment, i.e. homeostasis, are the goals of hemodialysis; it is also a process of removing the toxic and poisonous substances that cause permanent or fatal damages or injuries [1, 3]. Today, more than two hundred thousand people suffering from chronic renal failure in the United States of America and more than one million people worldwide are leading their lives on dialysis [2, 4]. Due to special physical and mental condition, dialysis patients undergo numerous problems; they spend three times a week, four hours each session, at the hospital and this means being away from home which, per se, brings significant impact on career plans, employment and economic status, self-esteem and high level of dependence [5, 6].

If hemodialysis does not have the necessary quality, level of blood toxins and patients' clinical symptoms will not be properly controlled and morbidly and mortality rate will be increased. The hemodialysis units' limitations such as number of dialysis machines, time and number of patients do not permit unlimited dialysis; hence, patients should be dialyzed within the limits so that it can improve their general condition and be economically and socially cost effective.

In dialysis, the clearance of urea is calculated by Kt/V formula, with the normal level of 1.2, in which K is the dialyzer clearance, depending on the filter blood flow and mass transfer coefficient (KoA) which is constant for each filter; T is the dialysis time, and V is the urea distribution volume in the body fluids, depending on height, gender, and weight. According to the reliable resources, levels less than 0.8 areconsidered to be a sign of inadequacy. The percent reduction in urea (PRU) has a direct and linear correlation with Kt/V index and is highly important. However, another index, the urea reduction ratio (URR), is also considered in researches with an acceptable level of up to 65% [4, 7]. If the urea reduction is inadequate, the dialysis will be inadequate regardless of the plasma urea. On the other hand, only low level of plasma urea is not indicative of adequate dialysis, and plasma level of which is not only depending

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on the amount of urea clearance but also the amount of urea production which, per se, is associated with the level of protein intake, and low level of plasma urea before dialysis may be due to low protein intake. Thus, in evaluating the adequacy, the important thing is the urea clearance in a four-hour stage of dialysis, and it is not merely correlated with plasma urea levels [8, 9].

Blood pressure is one of the most significant and determining factors in hemodialysis. Hypertension in adults, the systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥ 90 mmHg [8], is the second leading cause of chronic renal failure on one hand [8]; hypotension, on the other, is one of the most common complications of dialysis, occurring in 25% to 55% of cases in the second half of dialysis [8, 10].

The blood flow rate, in hemodialysis, is higher in diffusion mechanism in cases of small-molecular-weight substances such as urea and electrolytes. These materials are rapidly cleared, thereby more reducing the concentration gradients for diffusion; moreover, due to the direct effect on the dialysis machine pump speed, which shows the volume available for the materials exchange with dialysis fluid, they are effective on dialysis adequacy [9, 11]. In this regard, the present study was carried out to investigate the relationship between blood pressure and dialysis adequacy in patients to examine whether blood pressure affects the circulating blood volume as one of the factors influential on dialysis adequacy.

Methods

The present cross-sectional study was conducted on all non-emergency patients admitted to Besat(IRIAF) and Baqiyatallah hospitals in 2010 with definitive diagnosis of end stage renal failure by a nephrologist and at least six months of dialysis. Giving consent for participation and being in the age range of over 18 years were considered as inclusion criteria. A sample size of 100 was selected through the census method. Patients' records were used to collect the information, and a one-month blood pressure recorded before and after each dialysis session was evaluated for each patient. The pre- and post-dialysis median blood pressure of each patient was also considered during this period. Patients' demographic information was recorded as well.

To determine the adequacy of dialysis, prior to (through the arterial line before heparin injection) and after dialysis (2 to 3 minutes before sampling, the pump speed is set on 50ml/min, and through the arterial line before the filter),the blood samples are prepared in the last session of each month according to the conditions of dialysis units. Using the SIMEX apparatus in the laboratory, urea and cratinine levels were measured before and after dialysis, and Kt/V formula was applied to determine the adequacy of dialysis. The URR index was also calculated. Patients' weight was routinely measured prior to and following each dialysis session using a calibrated scale. The data obtained were analyzed by SPSS software through descriptive and inferential statistics (independent and paired t-tests).

Results

Among the total participant studied, with 62.21±13.7 and 4.42±3.4 years as the mean age and the mean dialysis duration respectively, 53 were male and 47 were female. Vascular access was through the fistula in 89% and the cortex in 8% of cases. The most common history of underlying disease leading to chronic renal failure and subsequent ESRD was related to diabetes (30%), blood pressure(24%),and both cases(17%) respectively;97% of the subjects had no history of kidney transplant. In the total study population, 43% and 5% were found with blood group A and AB respectively as the most and the least common blood groups. R6, PS10, and High-flux filters were used in 26%, 43%, and 12% of the study participants.

The mean dialysis adequacy index, Kt/V, was 1.23±0.38 and the mean URR index was 63.14±11.04 and within the acceptable level among the study participants.

Paired t-test showed a significant difference between the mean blood pressure, urea, as well aspre- and post-dialysis weight

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(p<0/001),which is due to the effects of hemodialysis; however, no remarkable difference was observed between systolic and diastolic blood pressure before and after dialysis in both genders (Table 1).

Likewise, there was no significant difference in patients' urea before and after dialysis and also the dialysis adequacy indices, Kt/V and URR, based on gender (Table 2).

According to the study performed, there was no linear correlation between blood pressure and dialysis adequacy indices, Kt/V and URR, demonstrating acceptable dialysis adequacy in patients with blood pressure higher and lower than the normal range, and based on the results achieved, other factors such as level of urea before and after dialysis play more significant role in the adequacy of dialysis.

Discussion

Findings of the present study revealed that only half of the patients studied (50.5%) had optimal dialysis adequacy, i.e. Kt/V greater than 1.2, and only 46%were found with URR more than 65%. Several investigations have shown the inadequacy of dialysis in various centers of Iran; in a study by Borzou et al. in Hamadan, for example, the mean Kt/V was reported to be greater than 1.2 (16.66%) [11]. Delavari et al. have also achieved similar results in a study in Kurdistan, indicating inadequacy of dialysis as 78.9% of patients have been observed with dialysis adequacy less than 1.2 [12];or in a study by Hojjat in 2009 in Jahrom, the adequacy of dialysis was acceptable in 17.64% of cases, showing higher level of dialysis adequacy in this research compared to other investigations, which can be due to educational nature of the center and the implementation of various researches resulting in continuing education and raising the awareness of the personnel and the patients [4, 13].

Similar to other studies, the number of men undergoing hemodialysis was more than women, as 53% male participated compared to 47% female in this study. This proportion was reported to be 55.6% to 44.4% by Ebrahimi et al. [14], 66% to 34% by Borzou et al. [11], and 64.7% to 35.3% by Hojjat [4]; in this regard, further studies are required to investigate the causes of renal failure in men.

The type of blood group in hemodialysis patients was the other point addressed in other studies. The blood groups A and AB were respectively the most (43%) and the least (5%) common types among the participants, raising the need for further and more comprehensive research in this field due to the remarkable difference observed.

The most common underlying disease leading to chronic renal failure and subsequent need for dialysis was related to diabetes (30%), blood pressure (24%), and both cases (17%), as also referred to in most of the books and

Table1. The frequency of blood pressure based on gender

BP / Gender	Systolic blood pressure		Diastolic blood pressure	
	Before dialysis	After dialysis	Before dialysis	After dialysis
Male	140.94 ± 25.7	130.95 ±26.23	79.6 ± 15.74	72.45 ± 15.11
Female	129.36 ± 24.06	119.98 ±24.43	72.55 ± 17.7	68.85 ± 16.73
Statistical test	Independent t-test p= 3.53	Independent t-test p= 3.60	Independent t-test p= 2.16	Independent t-test p= 2.07

Table2. The frequency of urea and dialysis adequacy based on gender

Variable / Gender	Urea		Kt/V	URR
	Before dialysis	After dialysis		
Male	88.83 ± 43.22	32.79 ± 15.54	1.17 ± 0.37	61.84 ± 9.52
Female	83.51 ± 37.47	26.98 ± 11.42	1.30 ± 0.38	64.61 ± 12.48
Statistical test	Independent t-test p= 5.93	Independent t-test p= 2.13	Independent t-test p= 0.052	Independent t-test p= 1.308

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studies inside and outside the country [8, 10,15], as well known and determining factors in kidney disease [16].

In this study, the mean pre- and post-dialysis blood pressure was respectively 135.76 and 125.70 and within the normal ranges according to the definitions of blood pressure. Blood pressure is one of the most important factors during dialysis, the increase or decrease of which is frequently observed in most of hemodialysis patients during dialysis [10],contributing to numerous complications and hemodialysis intolerance in patients, thereby significantly effecting dialysis adequacy [17]; however, considering frequent changes in blood pressure among dialysis patients in different sessions as well as getting used to the abnormal range of blood pressure, no direct linear correlation has been observed between blood pressure and dialysis adequacy in this study, and further investigations with more sample size are, therefore, recommended.

Conclusion

No linear correlation has been found between blood pressure and dialysis adequacy indices, Kt/V and URR, highlighting the need for more comprehensive researches with larger sample size. The present study also demonstrated acceptable adequacy of dialysis inpatients with blood pressure higher and lower than normal level, and regarding the results obtained, other effective factors such as pre- and post-dialysis level of urea play more significant role in the adequacy of dialysis.

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