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Effect of Timing of Hemodialysis on Bone Mineral Disease and Hemodialysis Adequacy in chronic kidney disease patients at Nephrology & Urology Hospital /Minia University

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(ESRD), Hemodialysis adequacy, Bone Mineral Disease and albumin level.

ABSTRACT

The number of patients being treated for end stage renal disease (ESRD) increased worldwide at a significant high rate. the Prevalence of ESRD in Egypt has amplified, Chronic kidney disease-mineral and bone disorders (CKD-MBD) are predominant in patients undergoing maintenance dialysis. Evaluate morning hemodialysis compared to night hemodialysis as regard to Bone Mineral Disease, hemodialysis adequacy and complete blood count allowing to participate in improving the outcome of hemodialysis(HD) patients. Cross-sectional study was conducted on 60 patients who settled in our dialysis units at Nephrology and UrologyUnit/ Minia University Hospital at both morning dialysis shift at (8am: 12pm) and evening shift (5pm: 9pm). There were statistically significant difference between the two hemodialysis shifts as regard to period of hemodialysis and number of medications taken by them and number of sessions per week and in corrected Calcium level (p value= 0.001 ,0.007, 0.014 and 0.031 respectively). Night hemodialysis was significantly higher in patients living in urban areas and Prevalence of uncontrolled diabetes (p< 0.001& 0.028 respectively). There were statistically significant differences between the morning and night hemodialysis patients regarding to period of hemodialysis, number of medications ,number of sessions per week and corrected Calcium level.

1. Introduction

Chronic kidney disease (CKD) was ranked as the 18th most common cause of death what showing a major impact on general health [1]. The incidence of end-stage renal failure (ESRF) requiring dialysis is expected to steadily grow at the fastest rate and has a major burden on healthcare cost even in developed countries [2]. The first type of kidney replacement therapy for the majority of patients is Dialysis, as transplantation as an initial modality is not available for all patients. [3], Although conventional hemodialysis is a life-

saving procedure for patients with ESRF and ameliorates many of clinical manifestations of ESRD and delays impending death. Butalso, the hemodialysis patients have higher morbidity and mortality, multiple hospitalizations compared with the general population [4]. It resolves the uremic syndrome partially but associated with the incidence of acute complications as hypotension, muscular spasm and disequilibrium syndrome and chronic disorders as anemia and bone mineral disease [5].

2. Patients and Methods

This cross-sectional study of 60 patients both male and female who registered at our dialysis unit at Nephrology & Urology Hospital /Minia University at either morning and evening hemodialysis shifts, 30 patients at morning dialysis shift (8am:12pm) and 30 patients at evening shift (5pm:9pm).It was conducted from July (2021) to January (2022) on patients who agreed to be interviewed and to participate in the study .The selected patients had age more than 18 years and undergo continuous Hemodialysis for at least 3 months. Whom their age <18 years, Severe ill or complicated patients or HD patients at afternoon dialysis shift were Excluded from our study. All Patients were subjected to: Full medical History taking, duration of dialysis treatment and dialysis shift timing, Arterial blood pressure measurement (pre dialysis - intradialytic - post dialysis) and Weight measurement (pre dialysis -post dialysis), Scales were used and calibrated for accuracy. Laboratory investigations were done to all patients as follows: Skin was cleaned with alcohol, Tourniquet was applied at upper mid arm, Blood sample of 6ml venous blood was obtained from the patients, Tourniquet was taken off and needle was removed from vein. Blood sample of each patient was subdivided into three parts each is 2ml. First part was used for complete blood count CBC. We put in EDTA tube to prevent coagulation [6]. Second &third part of Sample were coagulated for 5min. to obtain the clear serum for the tests then centrifuged at 3500 round per minute to detect Creatinine, urea, albumin, k, Na, Ca, Ph &PTH serum levels. Creatinine and urea were measured via modified urease Berthlot colorimetric method (7). Adjusting HD machine which allows high blood flows (250-400 ml/min) and of dialysis fluid flow (600-800 ml/min) was used [8]. Dialysis adequacy via percent of urea reduction ratio (URR), total clearance of urea normalized for distribution volume (Kt/V) were measured during dialysis using the following formula [9] (predialysis BUN-postdialysis BUN/ predialysis BUN).

Kt/V was calculated using the second-generation Daugirdas formula [10]

•Single-pool Kt/V = −In (R −0.008 × t) + (4 −3.5 × R)/UF ×W.

•Ethical consideration:

•The protocol was applied for approval of Research Ethics Committee. After clarifying the nature of the study and taking a verbal consent from participants, Data collected from them. All of them had the right to withdraw from the study without affecting their management. All data was kept confidential.

•Statistical Analysis:

•we were using SPSS version 23 for data processing. Data were conveyed as mean ± standard deviation (SD) for quantitative variables and. number and percentage for qualitative one

3. Results

A total of 60 HD patients whose age group ranged from (33.5-60) years. Concerning gender (58.3%) were males. The results revealed that the cause of ESRD was Hypertension in (36.6%) of patient while 83.3 % of all patients had uncontrolled hypertension, 30% had cardiac problems and 21.7% had uncontrolled diabetes. The results clarified that the median duration of patient from start dialysis was (period of HD) was 30 month. In regards to residency of the study sample (51.6%) of them are living in urban areas as shown in table (1). Our results showed that there was significant increase in number of sessions per week in patients

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with morning shift compared to night shift (p= 0.014) as shown in figure (1). Patients living in urban areas were significantly higher at night shift (p< 0.001) what shown in figure (2). Prevalence of uncontrolled diabetes was significantly higher in patients with night shift compared to morning hemodialysis (p= 0.028) as shown in figure (3). there was statistically significant difference between the two hemodialysis shifts as regard to period from starting dialysis and number of medications taken by them (p value= 0.001 &0.007 respectively) what was shown in table (2). The present study revealed that the mean Hb level was 10.1±2.3 g/dl &mean value of Kt/V was 1.3±0.1and mean URR 64.6±3.6. The mean corrected s. calcium, phosphorus& PTH were 8.3±0.9 mg/dL, 4.2±1.4 mg/dL and 358±326.6 pg/mL respectively what shown in table (3). there was significant elevation in corrected calcium level in patients with morning shift compared to night hemodialysis (p= 0.031) what clarified in table & figure (4), but there were no differences between patients with morning and night hemodialysis with respect to other laboratory data.

Table (1): Statistical distribution of the Patient's studied sample according to their Socio-demographic data.

		Studied cases (N=60)
Age	***Median*** ***IQR***	**41** **(33.5-60)**
Sex	***Male*** ***Female***	**35 (58.3%)** **25(41.6%)**
Duration	***Median*** ***IQR***	**30** **(10.5-72)**
Number of sessions / week	***Range*** ***Mean ± SD***	**(1-3)** **2.8±0.4**
Residence	***Rural*** ***Urban***	**29 (48.3%)** **31 (51.6%)**
Uncontrolled Diabetes	***No*** ***Yes***	**47(78.3%)** **13 (21.7%)**
Uncontrolled hypertension	***No*** ***Yes***	**10 (16.7%)** **50 (83.3%)**
Cardiac problems	***No*** ***Yes***	**42 (70%)** **18 (30%)**
Cause of Kidney disease	***Don't know*** ***HTN*** ***DM*** ***Polycystic kidney*** ***Ch. GN*** ***Ch. Pyelonephritis*** ***Others***	**5 (8.4%)** **22 (36.6%)** **9 (15%)** **4 (6.7%)** **5 (8.3%)** **6 (10%)** **9 (15%)**
No. of medications	**Median** **IQR**	**2** **(2-4)**

Table (2): Comparison between patients with morning and night hemodialysis as per demographic and clinical characteristics

		Morning	**Night**	**P value**
		N=30	**N=30**	
Period of HD	***Median*** ***IQR***	**60** **(36-87)**	**12** **(5-24)**	**<0.001***

Number of sessions / week	***Range*** ***Mean ± SD***	**(2-3)** **3±0.2**	**(1-3)** **2.7±0.5**	**0.014***
Residence	***Rural*** ***Urban***	**22(73.3%)** **8(26.7%)**	**7(23.3%)** **23(76.7%)**	**<0.001***
Un controlled Diabetes	***No*** ***Yes***	**27(90%)** **3(10%)**	**20(66.7%)** **10(33.3%)**	**0.028***
Un controlled Hypertension	***No*** ***Yes***	**7(23.3%)** **23(76.7%)**	**3(10%)** **27(90%)**	**0.166**
Cardiac problems	***No*** ***Yes***	**21(70%)** **9(30%)**	**21(70%)** **9(30%)**	**1**
Cause of Kidney disease	***Don't know*** ***HTN*** ***DM*** ***Polycystic kidney*** ***Ch. GN*** ***Ch. Pyelonephritis*** ***Others***	**3(10%)** **12(40%)** **2(6.7%)** **2(6.7%)** **3(10%)** **1(3.3%)** **7(23.3%)**	**2(6.7%)** **10(33.3%)** **7(23.3%)** **2(6.7%)** **2(6.7%)** **5(16.7%)** **2(6.7%)**	**0.185**
No. of medications	***Median*** ***IQR***	**2** **(1-3)**	**4** **(2-5)**	**0.007***
Pre-dialysis SBP	***Range*** ***Mean ± SD***	**(90-180)** **147.3±20.5**	**(110-190)** **153.7±21.9**	**0.252**
Pre-dialysis DBP	***Range*** ***Mean ± SD***	**(60-100)** **88.3±9.5**	**(70-120)** **91.3±10.7**	**0.257**
Intradialytic DBP	***Range*** ***Mean ± SD***	**(60-100)** **84±9.7**	**(70-100)** **86.7±8**	**0.250**
Post dialysis SBP	***Range*** ***Mean ± SD***	**(90-160)** **132.3±19.4**	**(100-160)** **135.7±17.9**	**0.493**
Post dialysis DBP	***Range*** ***Mean ± SD***	**(60-90)** **82.7±9.1**	**(60-100)** **83.7±8.5**	**0.661**
Pre dialytic weight	***Range*** ***Mean ± SD***	**(42-103)** **72.8±15.2**	**(42-124)** **75.9±19.4**	**0.484**
Post dialytic weight	***Range*** ***Mean ± SD***	**(40-101)** **70.1±15.1**	**(40-117)** **73.4±19**	**0.460**

Table (3): Distribution of the studied cases as regards laboratory data

		Studied cases (N=60)
Hb	***Range*** ***Mean ± SD***	**(4.1-16.6)** **10.1±2.3**
HCT	***Range*** ***Mean ± SD***	**(12.2-42)** **30.3±6.4**
TLC	***Median*** ***IQR***	**6.2** **(5.3-7.4)**
Platelets	***Median*** ***IQR***	**217.5** **(181.3-273)**
Cr	***Range*** ***Mean ± SD***	**(5.2-7.5)** **6.7±0.5**
Urea	***Range***	**(128-145)**

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	Mean ± SD	**136.4±3.9**
URR	***Range*** ***Mean ± SD***	**(65-75)** **64.6±3.6**
KT/V	***Range*** ***Mean ± SD***	**(1.2-1.4)** **1.3±0.1**
Corrected Total calcium	***Range*** ***Mean ± SD***	**(5.3-10.5)** **8.3±0.9**
Ionized calcium	***Range*** ***Mean ± SD***	**(0.6-1.2)** **1±0.1**
Ph	***Range*** ***Mean ± SD***	**(1.7-9.6)** **4.2±1.4**
PTH	***Range*** ***Mean ± SD***	**(20.1-1335)** **358±326.6**

Table (4): Comparison between patients with morning and night hemodialysis as per laboratory data and dialysis characteristics.

		Morning	**Night**	**P value**
		N=30	**N=30**	
Hb	***Range*** ***Mean ± SD***	**(5.3-14.4)** **10.5±2.1**	**(4.1-16.6)** **9.7±2.5**	**0.212**
HCT	***Range*** ***Mean ± SD***	**(12.3-42)** **31.6±6.5**	**(12.2-42)** **29±6.1**	**0.122**
TLC	***Median*** ***IQR***	**6** **(5.3-7.3)**	**6.4** **(5-7.5)**	**0.451**
Platelets	***Median*** ***IQR***	**203** **(169.8-265.5)**	**222.5** **(190.5-291.3)**	**0.089**
Cr	***Range*** ***Mean ± SD***	**(5.2-7.5)** **6.8±0.5**	**(5.9-7.5)** **6.6±0.4**	**0.223**
Urea	***Range*** ***Mean ± SD***	**(128-140)** **135.8±3.2**	**(129-145)** **137±4.5**	**0.225**
URR	***Range*** ***Mean ± SD***	**(65-73)** **68.7±2.4**	**(65-75)** **68.8±2.5**	**0.842**
KT/V	***Range*** ***Mean ± SD***	**(1.2-1.4)** **1.3±0.1**	**(1.2-1.4)** **1.3±0.1**	**0.063**
Corrected Total calcium	***Range*** ***Mean ± SD***	**(7-10.5)** **8.5±0.7**	**(5.3-9.7)** **8±1**	**0.031***
Ionized calcium	***Range*** ***Mean ± SD***	**(0.8-1.2)** **1±0.1**	**(0.6-1.2)** **1±0.1**	**0.749**
Ph.	***Range*** ***Mean ± SD***	**(2.4-5.7)** **3.8±0.9**	**(1.7-9.6)** **4.5±1.7**	**0.057**
PTH	***Range*** ***Mean ± SD***	**(20.1-1168)** **377±319.6**	**(28-1335)** **338.9±337.9**	**0.655**

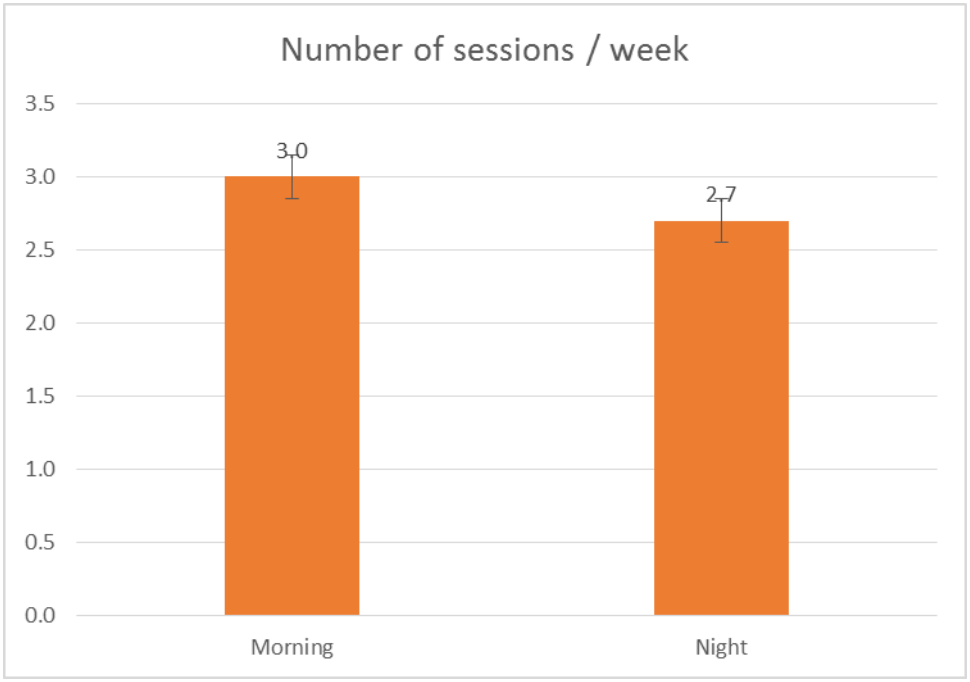

Figure (1): Comparison between patients with morning and night hemodialysis as regard number of sessions per week

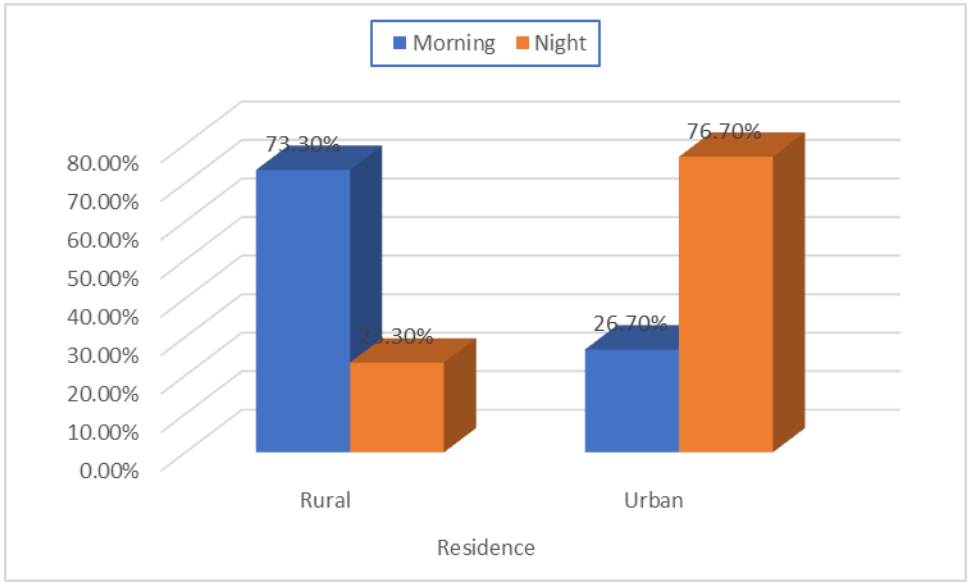

Figure (2): Comparison between patients with morning and night hemodialysis as regard to residence.

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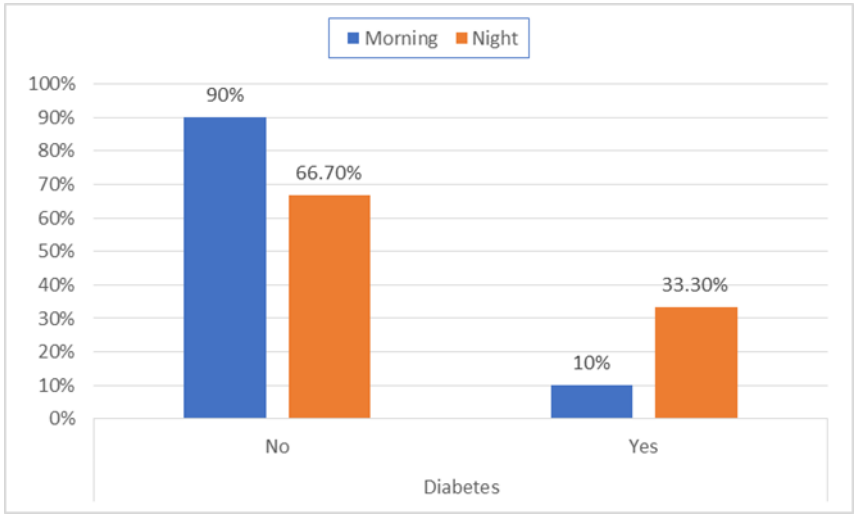

Figure (3): Comparison between patients with morning and night hemodialysis as regard to uncontrolled DM

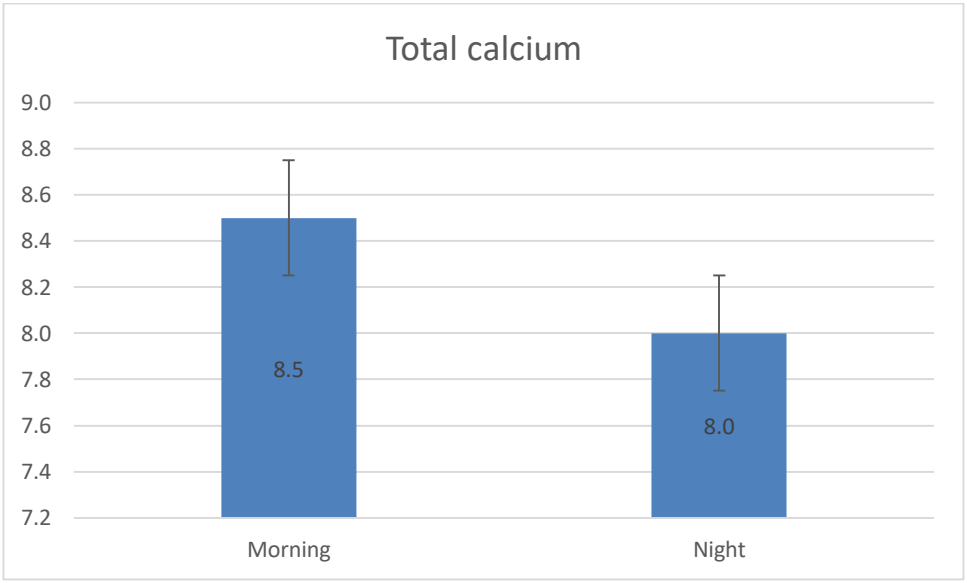

Figure (4): Comparison between patients with morning and night hemodialysis as regard to total corrected calcium level.

4. Discussion

Hemodialysis is a common renal replacement therapy for ESRD. Published data indicated that the hemodialysis dose is strongly associated with survival of dialysis patients [11]. The HD dose is quantified by the parameter Kt/V, which measures urea removal during treatment; KDOQI Guideline recommends a single-pool Kt/V of 1.2 is considered minimal adequate dose [12]. As regards dialysis adequacy, analysis of the results of the present study revealed that patients had Kt/V values were 1.3±0.1and URR 64.6±3.6 without significant difference between the two groups., indicating that patients were receiving an acceptable HD dose In agreement with those reported from developed countries such as the USA, patients had a Kt/V greater than 1.2 [13]. The mean Hb level was 10.1±2.3 g/dl in the study patients without significant difference between the two groups which met what was recommended by KDIGO guidelines for anemia [14], [15]. Alteration in bone mineral regulation as commonly seen in ESRD can cause soft tissue and vascular calcification as well as increase morbidity and mortality. KDOQI guidelines recommend maintaining corrected serum calcium levels 8.4-9.5 mg/dL, serum phosphorus 3.5-5.5 mg/dL and intact

parathormone levels between 100 and 500 pg/mL (11.0 to 55.0 pmol/L) (in CKDStage 5) [16]. Phosphorus and iPTH indices met KDIGO recommendations in our study and had no significant difference between the two groups what was supported by [17]. Only corrected s. calcium at arrange of 8.3±0.9 which slightly lower than the recommended corrected serum calcium in KDOQI guidelines. there was significant elevation in total calcium level in patients with morning shift compared to night hemodialysis (p= 0.031) which disagree with [18] who stated that no differences between patients with morning and night hemodialysis as regard to all laboratory data including corrected s. calcium. Our study found that there were significant increase in number of sessions per week in patients of morning shift compared to night shift (p= 0.014). Our results showed that statistically significant difference between the two groups in behalf of the morning shift as regard to period lasting from starting of hemodialysis (p value= 0.001) as hemodialysis patients in morning shift had prolonged period from starting hemodialysis which reflected to more survival. Our study found that there were significant increase in number of medications taken by them, living in urban areas and uncontrolled diabetes in night shift (p value= 0.007& 0.001 and 0.028 respectively). These results might be explained as the night shift had lesser connection with medical staff to detect the optimal medication required to each case, so no. of medications and un controlled diabetes increased what resulted in the period of hemodialysis were shortened compared to the morning shift.

5. Conclusion

There were significant difference in patients with morning shift compared to night hemodialysis as regard to number of sessions per week, number of medications taken by them, uncontrolled diabetes and corrected s. calcium level (p= 0.014 &0.007& 0.028 and 0.031respectively) what was reflected on length of hemodialysis period which was significantly greater in morning shift (p= 0.001).

Recommendations

1-supply our dialysis unit with more medical staff especially in evening shifts to follow up the patients and prescribe the optimal hemodialysis dose and medications required. 2-Further studies on larger sample size to emphasize our conclusion

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