ECG CHANGES BEFORE AND AFTER HEMODIALYSIS

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ABSTRACT

Objectives: To assess the effect of hemodialysis on T to R wave ratio and QT dispersion, which may lead to cardiac arrhythmias and sudden death in renal failure patients under hemodialysis with or without myocardial ischemia and diabetes mellitus.

Study design: Fifty patients with chronic renal failure under hemodialysis were included in this study; they were divided into ischemic and non-ischemic groups, and diabetic and non-diabetic groups. A predialysis and postdialysis 12 lead ECGs were recorded and analyzed to obtain QT interval, QT dispersion, amplitudes of the T and R waves; Serum potassium, urea, creatinine, sodium, calcium, magnesium and bicarbonate levels were measured before and after hemodialysis. All the previous parameters were compared between the groups and inside each group before and after dialysis.

Results: there was a marked increase in QT dispersion postdialysis from 51.6±16.7 to 92.4±22 ms ($p<0.001$), a significant decrease in minimum QT from 346.4±33 to 314±28.6 ms ($p<0.001$), a significant decrease in T wave amplitude from 6.3±2.9 to 4.2±2.4 mm ($p<0.001$), when ischemic and non- ischemic groups were compared there was a significantly higher QT dispersion even predialysis 64±17.8 ms in ischemic group and 43.3±9.2ms in non- ischemic group ($p<0.001$), which was maintained postdialysis, there was a significantly lower minimum QT interval in ischemic group postdialysis only 303 ±21.7 vs. 321.3±30.5 ms in non-ischemic group ($p<0.05$).

Conclusion: chronic renal failure patients under hemodialysis are more susceptible to cardiac arrhythmias and sudden death especially during d after hemodialysis, this risk increase in patients with myocardial ischemia.

INTRODUCTION

Cardiovascular disease is a major cause of mortality and morbidity among subjects on hemodialysis. It is responsible for up to 50% of deaths among subjects on dialysis.[1] Cardiac arrhythmias are frequent among the hemodialysis population, particularly during and immediately after a dialysis session. [2] These arrhythmias may be caused by the rapid changes in intracellular and extracellular electrolytes during the dialysis session. [3]

QT dispersion has emerged as an important predictor of ventricular arrhythmias. It is simply the difference between the shortest and longest QT interval. It represents a non-invasive measurement of myocardial repolarization in homogeneity and hence predisposition to re-entry arrhythmias. [4] **A** QT dispersion above 80 ms found to reflects a loss of synchronization in the repolarization process. [5]

Hyperkalemia reduces the resting membrane potential, slows the conduction velocity and increases the rate of repolarization. Hypokalemia on the other hand increases the resting membrane potential, and increases the duration of action potential and refractory period, which are potentially arrhythmogenic. [6] The aim of the present study is to assess the effect of hemodialysis on T to R wave ratio and QT dispersion.

PATIENTS AND METHODS

Patients: A total number of 50 patients with chronic renal failure on hemodialysis were randomly included in this study.

Inclusion criteria: The patients included in this study if they have chronic renal failure on hemodialysis.

Exclusion criteria: (patients with known causes of prolonged QRS duration were excluded): Patient with complete right and left bundle block, Patient on pacemaker rhythm, Patients on drugs known to prolong QT interval (e.g. amiodaron, quinidine - tricyclic antiderpressants - phenothiazines…..etc).

Methods: All patients were subjected to the following:

1- Full medical history and thorough clinical examination: duration of hemodialysis sessions was noted.

2- Electrocardiography: 12 lead surface resting electrocardiograms were done before

and after hemodialysis session (with paper speed 25 mm/s and gain of 1mm/mV) and carefully analyzed for:

a) **QT interval:** The QT interval was measured from the start of the QRS complexes to the end of T wave that is to the point where T wave returned to the isoelectric line or, when a U wave was present, at the nadir between the T wave and the U wave. In order to allow for changes in heart rate during dialysis, all QT intervals were corrected for heart rate by dividing by the square root of the R-R interval (Bazett's formula). [7]

b) **QT dispersion (QTd):** is measured by the difference between the maximum QTc interval and minimum QTc interval occurring in any of the 12 electrocardiographic leads (normal value up to 50 ms). [7]

c) **Amplitudes of T and R waves:** was measured in V_4 or the lead with the maximum R-wave deflection. (If not V_4). Then the T to R ratio was calculated. [8]

d) Evidence of ischemic changes and left ventricular hypertrophy.

3- Laboratory investigations:

-Serum potassium, serum urea and creatinine, serum sodium, serum calcium, serum magnesium and serum bicarbonate level were measured before and after hemodialysis.

- **Creatinine clearance** was calculated by Cockcroft-Gault Equation to predict GFR based on serum creatinine equation:

Creatinine clearance (male) = ([140-age] × weight in kg) / (serum creatinine × 72) (Normal range = 110 to 120 milliliters per minute)

Creatinine clearance (female) = Creatinine clearance (male) × 0.85.

(Normal range = 100 to 110 milliliters per minute). [9]

- **Diabetes mellitus** diagnosed by plasma glucose > 126 mg / dL or venous plasma glucose 2 h after a 75 g oral glucose load > 200 mg / dL or the presence of any glucose in a urine sample passed 2 h after a main meal[10]

4- Transthoracic Echocardiography (TTE): was performed to assess cardiac dimensions, wall thickness and functions and presence of left ventricular hypertrophy and wall motion abnormalities for diagnosis of myocardial ischemia. Echocardiography was preformed according to the 2011 Appropriate Use Criteria for Echocardiography. [11]

Study design: The patients were selected based on simple random sampling of consecutive patents presented to hemodialysis unite in Zagazig university hospitals, the patients were retrogradely divided into ischemic and non-ischemic groups according to the presence of evidence for ischemic heart disease.

Ischemic group: included 20 patients, 12 males (60%) and 8 females (40%) with mean age of 49.35±14 years.

Non- ischemic group: included 30 patients, 12 males (40%) and 18 females (60%) with mean age of 47.7±13 years.

Also our population divided into diabetic and non-diabetics according to the presence of diabetes mellitus.

Diabetic group: included 35 patients, 20 males (57%) and 15 females (43%) with mean age of 48 ±15 years.

Non-diabetic group: included 15 patients, 9 males (60%) and 6 females (40%) with mean age of 50.1±12 years.

ECG and laboratory parameters were compared before and after dialysis, in the whole sample and between and inside groups.

Statistical analysis: All data were analyzed using SPSS, version 16. Continuous variables were expressed as mean and standard deviation (SD); Continuous variables were compared between 2 independent groups using the unpaired Student t-test for normally distributed data, and in the same group pre and post dialysis using Paired-Samples t-test for normally distributed data. Statistical significance was set at $P < 0.05$.

RESULTS

There were highly significant changes in the urea, creatinine clearance, serum K level, serum bicarbonate, QTc interval minimal and T wave amplitude in the whole study population after hemodialysis. And significant differences as regards the serum creatinine level, Sodium, Ca++, Mg ++ and T to R wave ratio, while there were no significant change

occurred with hemodialysis in QTc max and R wave amplitude in the ECG. (As shown in table 1)

The ischemic patients have significantly longer duration of hemodialysis than the non-ischemic patients. (As shown in table 2)

Table (3) shows: comparison between ischemic and non-ischemic patients: before dialysis, the QTc dispersion was significantly higher in ischemic than in non-ischemic patients. And after dialysis, there were significant difference between ischemic and non-ischemic patients in the serum creatinine level, min QTc interval and highly significant difference in QTc dispersion.

As shown in Table (4): inside the ischemic group, there were highly significant change after hemodialysis in the serum Bicarbonate level, Min QTc interval, T wave amplitude and T to R waves ratio in the ECG. And there were significant change in serum level of Sodium, Potassium, Ca++, Mg++, Urea, creatinine, creatinine clearance and QT dispersion in the ECG. While, there was no significant change in the Max QTc interval after hemodialysis. With the same level of changes inside the non-ischemic group before and after hemodialysis.

Table (5) shows: comparison between diabetic and non-diabetic patients, before dialysis, the creatinine clearance was significantly higher in non-diabetics than in diabetics. And after dialysis, the there were significant difference between diabetic and non- diabetic patients in the creatinine clearance and Min QTc interval.

As in table (6): inside the diabetic group, there were highly significant change after hemodialysis in the serum Bicarbonate level, Min QTc interval, T wave amplitude and T to R waves ratio in the ECG. And there were significant change in serum level of Sodium, Potassium, Ca++, Mg++, Urea, Creatinine, creatinine clearance and QT dispersion in the ECG. While, there was no significant change in the Max QTc interval after hemodialysis. With nearly the same level of changes inside the non-diabetic group before and after hemodialysis except for the min QTc interval which showed only significant change.

DISCUSSION

In our study there were highly significant changes in the serum urea,
serum K+ level, serum bicarbonate, And significant change in serum creatinine level with hemodialysis. Also, creatinine clearance showed a highly significant increase after dialysis this means effectiveness of the hemodialysis in our patients. This result is in agreement with **Kirschbaum** [12] who found changes in serum urea, creatinine, creatinine clearance, bicarbonate and serum potassium level with hemodialysis and stated that; serum creatinine changes is widely used to assess the efficacy of dialysis. In our study we found that the mean values of QT dispersion showed a highly significant increase after dialysis this was attributed to prolongation in maximum QTc (dose not reach significant level) as well as significant decrease in minimum QTc (highly significant change) these results are in agreement with **Malhis et al.** [13] who found that the mean QT dispersions changed significantly after hemodialysis. ($p < 0.01$)

Table (1): shows pre and post dialysis laboratory and ECG data in all study population.

Variable	*Predialysis*	*Postdialysis*	*P*
Urea (mg/dl)	131.2±30	47 .6± 13.2	<0.001
Creatinine(mg/dl)	7 ± 1.3	9.6 ± 4.3	< 0.05
Creatinine cl(ml/min)	11.5 ±2.7	24 ±7.8	<0.001
Potassium (mEq/L)	4.5±0.7	3.4 ± 0.55	<0.001
Sodium (mEq/L)	132.8 ± 2.4	135 ± 2.6	<0.05
Ca++ (mg/dl)	2.6 ± 0.8	2.3 ± 0.4	<0.05
Mg++ (mg/dl)	0.7 ± 0.5	0.5 ± 0.3	<0.05
Bicarbonate (mg/dl)	22.1 ± 5	25.5 ± 4.2	<0.001
Max QT (ms)	396.4 ± 34	398.4± 58.9	> 0.05
Min QT (ms)	346.4 ± 33	314 ± 28.6	<0.001
QT disp. (ms)	51.6 ± 16.7	92.4 ± 22	<0.001
T wave (mm)	6.3 ± 2.9	4.2 ±2.4	<0.001
R wave (mm)	7.4 ± 7.1	9.8 ± 8.6	>0.05
T to R ratio	0.92 ± 0.83	0.51 ± 0.6	< 0.05

Table (2): shows clinical data of ischemic and non-ischemic groups.

Variable		*Ischemic (20)*		*Non- ischemic (30)*		*P*
		X ± SD		*X ± SD*		
Age (ys)		49.35 ± 14		47.70 ± 13		> 0.05
Duration (ys)		5.5 ±3.7		5.2 ± 2.8		< 0.05
Variable		*N*	*%*	*N*	*%*	*P*
Sex	*Male*	12	60	12	40	> 0.05
	Female	8	40	18	60	
Diabetic		15	75	20	67	> 0.05
Hypertensive		14	70	16	53	> 0.05

Table (3): shows the differences between ischemic and non-ischemic patients before and after hemodialysis.

Variable	*Predialysis*		*P*	*Postdialysis*		*P*
	Ischemic	*Non-ischemic*		*Ischemic*	*Non-ischemic*	
Urea (mg/dl)	132.2± 30.2	130.6 ± 30.4	> 0.05	47.9 ±13.5	47.47 ± 13.2	> 0.05
Creatinine (mg/dl)	6.94 ± 1.4	7.09± 1.2	> 0.05	2.8 ± 2	3.5 ± 1	< 0.05
Creatinine cl(ml/min)	10.8 ± 2.2	11.9 ± 2.9	> 0.05	22.3 ±7.2	25.1 ± 8.1	> 0.05
Potassium (mEq/L)	4.4 ± 0.8	4.6 ± 0.7	> 0.05	3.4 ± 0.5	3.47 ± 0.6	> 0.05
Sodium (mEq/L)	132.8 ± 2.4	135.7 ± 2.5	> 0.05	135 ± 2.6	134 ± 2.6	> 0.05
Ca++ (mg/dl)	2.6 ± 0.8	2.71 ± 0.87	> 0.05	2.3 ± 0.4	2.2± 0.5	> 0.05
Mg++ (mg/dl)	0.7 ± 0.5	0.8 ± 0.65	> 0.05	0.54± 0.5	0.59± 0.4	> 0.05
Bicarbonate (mg/dl)	22 ± 5	23 ± 6	> 0.05	25.5 ± 4	26.5 ± 4	> 0.05
Max QT (ms)	404 ± 34	391.3 ± 33.5	> 0.05	401 ±86.9	396.7 ±30.2	> 0.05
Min QT (ms)	344 ± 30.1	348 ± 35	> 0.05	303 ± 21.7	321.3 ± 30.5	< 0.05
QT dispersion (ms)	64 ± 17.8	43.3 ± 9,2	<0.001	116 ± 8.2	76.7 ± 11.8	<0.001
T wave (mm)	6.3 ± 2.9	6.5 ± 3	> 0.05	4.2 ±2.4	4.4 ±2.3	> 0.05
R wave (mm)	7.4 ± 7.1	7.2 ± 6.9	> 0.05	9.8 ± 8.6	9.6 ± 8.7	> 0.05
T to R ratio	0.9 ±0.7	0.9 ± 0.5	> 0.05	0.44 ± 0. 3	0.51 ± 0.22	> 0.05

Table (4): shows the changes occurred in ischemic and non-ischemic patients before and after hemodialysis

Variable	Ischemic		P	Non- ischemic		P
	Predialysis	Postdialysis		Predialysis	Postdialysis	
Urea (mg/dl)	130.6 ± 30.4	47.47 ± 13.2	< 0.05	132.2± 30.2	47.9 ±13.5	< 0.05
Creatinine (mg/dl)	7.09± 1.2	3.5 ± 1	< 0.05	6.94 ± 1.4	2.8 ± 2	< 0.05
Creatinine cl(ml/min)	11.9 ± 2.9	25.1 ± 8.1	< 0.05	10.8 ± 2.2	22.3 ±7.2	< 0.05
Potassium (mEq/L)	4.6 ± 0.7	3.47 ± 0.6	< 0.05	4.4 ± 0.8	3.4 ± 0.5	< 0.05
Sodium (mEq/L)	132 ± 2.4	135.2 ± 2.6	<0.05	132.6 ± 2.4	136 ± 2.6	<0.05
Ca++(mg/dl)	2.7 ± 0.8	2.4 ± 0.4	<0.05	2.7± 0.8	2.2 ± 0.4	<0.05
Mg++(mg/dl)	0.7 ± 0.5	0.54± 0.5	< 0.05	0.8 ± 0.65	0.59± 0.4	<0.05
Bicarbonate (mg/dl)	22 ± 5	25.5 ± 4	<0.001	22 ± 5	25.5 ± 4	<0.001
Max QT (ms)	391.3 ± 33.5	396.7±30.2	> 0.05	404 ± 34	401 ±86.9	> 0.05
Min QT (ms)	348 ± 35	321.3±30.5	<0.001	344 ± 30.1	303 ± 21.7	<0.001
QT dispersion (ms)	43.3 ± 9,2	76.7 ± 11.8	< 0.05	64 ± 17.8	116 ± 8.2	< 0.05
T wave (mm)	6.4 ± 2.9	4.3 ±2.4	<0.001	6.5± 2.9	4.1 ±2.4	<0.001
R wave (mm)	7.3± 7.2	9.7± 8.5	>0.05	7.3± 7	9.6± 8.6	>0.05
T to R ratio	0.87± 0.21	0.42 ± 0. 23	< 0.001	0.91 ±0.5	0.43 ± 0.32	<0.001

Table (5): shows the differences between diabetic and non-diabetic patients before and after hemodialysis.

Variable	Predialysis		P	Postdialysis		P
	Diabetic	Non-diab.		Diabetic	Non-diab.	
Urea (mg/dl)	139±42.39	133.2±31.6	> 0.05	50.14±16.5	49.35±13.26	> 0.05
Creatinine (mg/dl)	6.10±1.26	7.09±1.11	> 0.05	3.35±1.11	3.43±1.09	> 0.05
Creatinine cl(ml/m)	11.12±2.1	13.21±3.42	<0.001	22.46±5.43	25.64±9.80	< 0.05
Potassium (mEq/L)	4.64±0.87	4.57±0.73	> 0.05	3.47±0.67	3.49±0.54	> 0.05
Sodium (mEq/L)	132.8 ± 2.4	131.8 ± 2.3	> 0.05	135 ± 2.6	136 ± 2.2	> 0.05
Ca++ (mg/dl)	2.6 ± 0.8	2.5± 0.9	> 0.05	2.3 ± 0.4	2.4± 0.4	> 0.05
Mg++ (mg/dl)	0.7 ± 0.5	0.71 ± 0.6	> 0.05	0.57 ± 0.5	0.56± 0.6	> 0.05
Bicarbonate (mg/dl)	22 ± 5	23 ± 5	> 0.05	25.5 ± 4	25.8± 6	> 0.05
Max QT (ms)	411.4±27.9	396±37.04	> 0.05	414.28±19	413±28.48	> 0.05
Min QT (ms)	348.6±38	342±33.02	> 0.05	314.3 ±27.6	313±25.36	< 0.05
QT dispersion (ms)	62.9±17.9	56±19.02	> 0.05	100±20	100±20.51	> 0.05
T wave (mm)	6.3 ± 2.9	6.6± 2.6	> 0.05	4.2 ±2.4	4.4±2.4	> 0.05
R wave (mm)	7.4 ± 7.1	7.3 ± 7.2	> 0.05	9.8 ± 8.6	9.5 ± 8.4	> 0.05
T to R ratio	0.85±0.8	0.91±0.81	> 0.05	0.43±0.33	0.45±0.25	> 0.05

Table 6 Shows the changes occurred in diabetic and non-diabetic patients before and after hemodialysis.

Variable	*Diabetic*		*P*	*Non-diabetic*		*P*
	Predialysis	*Postdialysis*		*Predialysis*	*Postdialysis*	
Urea (mg/dl)	139±42.39	50.14±16.5	< 0.05	133.2±31.6	49.35±13.26	< 0.05
Creatinine (mg/dl)	6.10±1.26	3.35±1.11	< 0.05	7.09±1.11	3.43±1.09	< 0.05
Creatinine cl(ml/min)	11.12±2.09	22.46±5.43	< 0.05	13.21±3.42	25.64±9.80	< 0.05
Potassium (mEq/L)	4.64±0.87	3.47±0.67	< 0.05	4.57±0.73	3.49±0.54	< 0.05
Sodium (mEq/L)	132.8 ± 2.4	135 ± 2.6	<0.05	132.4 ± 2.4	135 ± 2.6	<0.05
Ca++ (mg/dl)	2.6 + 0.8	2.3 ± 0.4	<0.05	2.6 ± 0.9	2.4 ± 0.4	<0.05
Mg++ (mg/dl)	0.7 ± 0.5	0.57 ± 0.5	<0.05	0.71 ± 0.6	0.56± 0.6	<0.05
Bicarbonate (mg/dl)	22 ± 5	25.5 ± 4	<0.001	22 ± 5	25.5 ± 4	<0.001
Max QT (ms)	411.4±27.9	414.28±19.02	> 0.05	396±37.04	413±28.48	< 0.05
Min QT (ms)	348.6±38.4	314.28±27.6	<0.001	342±33.02	313±25.36	< 0.05
QT dispersion (ms)	62.85±17.99	100±20	< 0.05	56±19.02	100±20.51	< 0.05
T wave (mm)	6.2± 2.8	4.1 ±2.4	<0.001	6.1± 2.7	4.4 ±2.6	<0.001
R wave (mm)	7.6± 7	9.6± 8.7	>0.05	7.6 ± 7.4	9.3 ± 8.3	>0.05
T to R ratio	0.85±0. 28	0.44±0.32	<0.001	0.81±0.78	0.48±0.35	< 0.001

Wu et al. [14] explained prolonged QT dispersion in dialysis patients by the changes of cellular or interstitial fluid composition that might account for the increased ventricular repolarization in hemodialysis patients. Potassium, calcium, magnesium and metabolic acidosis are important factors for the electrical stability of the myocardium involved in creating normal cellular excitability, impulse propagation and regular ventricular recovery. This in agreement with our study which showed significant changes in the serum Sodium, Potassium, Ca++, Mg++ and bicarbonate level with hemodialysis. These results also, in agreement with **Lorincz et al.** [15]

Also **Futrakul et al.** [16] showed that increase in QT dispersion during the first hour of hemodialysis, when arrhythmias frequently occur, was inversely correlated with the rapid removal of serum potassium.

In our study, patients with ischemic heart disease (before dialysis), the QT dispersion was highly significantly higher in ischemic than in non-ischemic patients. And after dialysis, there were significant difference between ischemic and non-ischemic patients in the serum creatinine level, min QTc interval and highly significant difference in QT dispersion. And inside the ischemic group, there were highly significant change after hemodialysis in the serum Bicarbonate level, Min QTc interval, T wave amplitude and T to R wave ratio in the ECG. And there were significant change in serum level of Sodium, Potassium, Ca++, Mg++, Urea, Creatinine, creatinine clearance and QT dispersion in the ECG. While, there was no significant change in the Max QTc interval after hemodialysis. With the same level of changes inside the non-ischemic group before and after hemodialysis. These results are in agreement with **Sanai et al**. [17] who studied patients on dialysis and one group with preexisting ischemic heart disease and the other group patients without known ischemic heart disease. In the group of patients with preexisting ischemic heart disease, QT dispersion was significantly higher postdialysis when compared with the patients without known ischemic heart disease. However, the changes in QT dispersion during dialysis remained significant in the patients without ischemic

heart disease, suggesting that the dialysis process itself influences these parameters.

Also, **Malhis et al.** [13] found that; the patients with pre-existing coronary artery disease had significantly longer QTc intervals and greater QTc dispersion pre and post hemodialysis so this group of patients may be at higher risk for ventricular fibrillation and sudden death and the prolongation of these parameters may be a further noninvasive marker of susceptibility to ventricular arrhythmias

Veglio et al. [18] mentioned that, In ESRD patients many factors can contribute to QTc interval prolongation, such as electrolyte abnormalities, associated conditions (for example diabetes, heart failure, left ventricular hypertrophy and autonomic neuropathy) and therapies. Moreover, ESRD patients are a very heterogeneous population, often in unstable clinical conditions: this situation may influence results of cardiovascular testing and makes comparisons among studies rather difficult**.**

In our study population we found statistically highly significant decrease in the T wave amplitude, no significant increase in the R wave amplitude and significant decrease in the T to R ratio after hemodialysis.

This was in agreement with Santoro et al. [19] who found that ECG parameters significantly changed post hemodialysis; the T wave amplitude decreased, and the R wave amplitude increased. And significantly decreased the T to R wave ratio post dialysis and they concluded that after hemodialysis; serum potassium decrement results in a decrease in T to R wave ratio on ECG; this change may have an arrhythmogenic potential.

Lin et al. [20] also found that; the T wave amplitude decreased, and the R wave amplitude increased which is in agreement with our study and explained these changes in T and R wave to serum potassium levels and are representative of repolarization heterogeneity.

Shapira and Khayim [21] studied ECG changes in chronic renal failure patients on hemodialysis and they found that the most frequent changes in ECG were a decrease in T wave amplitude, an increase of QRS amplitude (61% of patients), shortened or prolonged QTc interval (61%) and ischemic-like ST-T changes (22% and 39%, respectively). Potentially clinically significant arrhythmias occurred in 12 patients (31%) of which 8 were supraventricular, 3 were combined ventricular and supraventricular, and 1 was pure ventricular. The only clinically identified risk factor for complex ventricular and supraventricular arrhythmia was advanced age. The arrhythmia and non-arrhythmia groups differed significantly in their predialysis hematocrit, O2 content, serum urea, and osmolarity, and in their postdialysis serum phosphorus and osmolarity. The results indicate that patients with chronic renal failure frequently exhibit ECG changes and a high incidence of ventricular and supraventricular arrhythmias, which may be prognostically significant, during and after hemodialysis.

In agreement with our study **Aslam et al.** [22] who measured the mean pre-dialysis serum potassium concentration which was 4.9±0.71 mEq/l , Mean pre-cordial lead T wave amplitude which was 5.1±4.1 mm and the mean T wave to R wave ratio which was 0.3±0.1 mm and he found that T wave amplitude was equivalent in patients with serum potassium concentration > 5.5 or ≤5.5 mEq/l. Also, T wave to R wave ratio was equivalent in patients with serum potassium concentration > 5.5 or ≤ 5.5 mEq/l. So he concluded that; there was no difference in T wave amplitude or T wave to R wave ratio between those with low or high pre-dialysis serum potassium concentration.

In comparison between diabetic and non-diabetic patients, before dialysis, the Creatinine clearance was significantly higher in non-diabetics than in diabetics. And after dialysis, the there were significant difference between diabetic and non- diabetic patients in the Creatinine clearance and Min QTc interval. Inside the diabetic group, there were highly significant changes after hemodialysis

in the serum Bicarbonate level, Min QTc interval, T wave amplitude and T to R wave ratio in the ECG. And there were significant change in serum level of Sodium, Potassium, Ca++, Mg++, Urea, Creatinine, creatinine clearance and QT dispersion in the ECG. While, there was no significant change in the Max QTc interval after hemodialysis. With the nearly same level of changes inside the non-diabetic group before and after hemodialysis except for the min QTc interval which showed only significant change. These results are in agreement with **Malhis et al.** [13] who found correlation between prolonged QTc interval and diabetes mellitus and explained that; in diabetics; cardiac autonomic neuropathy is well known and is associated with QT prolongation. And the fact that; Hyperglycemia per se can affect QT interval

CONCLUSION

In conclusion, this study showed that QTc max and QT dispersion, which are known markers of risk for arrhythmias and sudden death, are elevated in hemodialysis patients, and rise postdialysis. The mechanisms responsible are unclear but may reflect myocardial ischemia in those patients with known ischemic heart disease (mediated through a fall in diastolic BP during dialysis), or changes in acid-base status in patients without ischemic heart disease. Additional larger studies are required to assess the importance of QT dispersion on cardiovascular outcome in chronic renal failure, and QT dispersion may prove a novel target for intervention studies to reduce sudden death in this high-risk population. And that; In ESRD patients many factors can contribute to QT interval prolongation and T to R wave ratio, such as electrolyte abnormalities, associated conditions (for example diabetes, heart failure, left ventricular hypertrophy and autonomic neuropathy) and therapies. Moreover, the ESRD patients are a very heterogeneous population, often in unstable clinical conditions: this situation may influence results of cardiovascular testing.

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تغيرات تخطيط القلب الكهربي قبل وبعد غسيل الكلي الدموي

المقدمة: من المعروف أن أمراض القلب هي سبب رئيسي من أسباب الوفيات بين المرضى اللذين يجرون الغسيل الكلوي، فهي مسئولة عن ما يقرب من ٥٠٪ من هذه الوفيات. كما يعتبر عدم انتظام ضربات القلب المتكرر بين مرضى الغسيل الكلوي وخاصة أثناء وبعد دورة الغسيل من أهم أسباب حدوث الوفاة و الذي قد ينتج عن التغيرات السريعة في شوارد السوائل داخل وخارج الخلايا أثناء دورة الغسيل الكلوي.

الهدف من البحث: بيان تأثير غسيل الكلي الدموي علي كل من الموجتين (تي) و (آر) وتشتت فترة (الكيو- تي) في تخطيط القلب الكهربي ، والذي قد يؤدى إلى اضطراب في نظم القلب والموت الفجائي في المرضي تحت غسيل الكلي الدموي المصحوب أو غير المصحوب بقصور الشرياني التاجي و مرض البول السكري.

المرضى و طرق البحث: ضمت هذه الدراسة خمسون مريضا بالفشل الكلوي المزمن تحت الغسيل الكلوي الدموي، تم تقسيم المرضى إلى مجموعتين على أساس مرض قصور الشريان التاجي، ثم تم تقسيم نفس المرضى الى مجموعتين على حسب الإصابة بمرض السكري. للوقوف على تأثير مرض قصور الدورة التاجية و مرض السكري. وقد تم عمل تخطيط للقلب قبل و بعد الغسيل وتم قياس وتحليل كل من فترة (الكيو-تي) لاستنباط التشتت في موجة (الكيو-تي) و تم قياس كل من سعات موجتي (آر) و (تي)، كما تم قياس التركيز المصلي لكل من البوتاسيوم والبولينا والكرياتينين و الصوديوم والكالسيوم والماغنيسيوم و البيكربونات قبل وبعد الغسيل. وقد تمت مقارنة كل المعطيات فيما بين المجموعات.

النتائج: لقد وجدت زيادة ذات دلالة إحصائية في زمن و تشتت فترة (الكيو-تي) بعد الغسيل الكلوي ، كما وجد انخفاض ذو دلالة إحصائية في اقل زمن لفترة (الكيو- تي)، ووجد انخفاض في ارتفاع الموجه (تي) بعد الغسيل ، و وزيادة دون الدلالة الإحصائية في ارتفاع الموجة (آر) و انخفاض ملحوظ في نسبة (تي : آر) بعد غسيل الكلى.
وعند مقارنة المرضي الذين يعانون من قصور الشريان التاجي باللذين لا يعانون منه وجدت زيادة ذات دلالة إحصائية في تشتت فترة (الكيو –تي) قبل الغسيل واستمرت بعد الغسيل في المرضي اللذين يعانون من قصور الشريان التاجي، وكان هناك انخفاض ذو دلالة إحصائية في اقل زمن لفترة (الكيو-تي) في المرضي الذين يعانون من قصور الشريان التاجي بالنسبة للذين لا يعانون منه فيما بعد الغسيل الكلوي.

الخلاصة:- أظهرت هذه الدراسة أن زمن وتشت فترة (الكيو – تي) ، والتي تعرف أنها من علامات الخطر لعدم انتظام ضربات القلب والموت الفجائي ، كانت أطول في مرضى الفشل الكلوي و تزداد ارتفاعا بعد دورة الغسيل.
مما يوضح السبب في أن مرضي الفشل الكلوي المزمن تحت الغسيل الكلوي الدموي معرضون لاضطراب ضربات القلب والموت الفجائي بنسبة اكبر وبالذات في أثناء إجراء الغسيل الدموي و بعده مباشرة وهذا الخطر يزداد في حال إصابتهم بقصور الشرايين التاجية.