Effect of Nursing guidelines to reduce Complications of Acetate and Bicarbonate Solutions during Hemodialysis among Acute Renal Failure Patients, Assuit University Hospital

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Abstract: Critically ill patients with acute renal failure who receiving the dialysis therapy were suffered from many complication: dialysate during hemodialysis session. **Aim**: this study was carried out to investigate the effect of nursing guidelines for Complications of acetate and bicarbonate Solutions during hemodialysis among acute renal failure patients, Assuit University Hospital. **Design**: Quasi experimental design. **Setting**: This study was carried out at hemodialysis unit, ICUs Assuit University Hospital. **Subjects**: Sixty adult male and female critically ill patients with acute renal failure who are admitted to hemodialysis unit. **Tools**: Two tools were developed by the researcher and used in this study which are; **tool I**: Personal and medical data sheet and hemodialysis**, tool II:** Hemodialysis complications assessment sheet. **Methods:** Interview, observation and reviewing patient`s records where utilized to collect data pertinent to the study. Each patient was monitored closely and give nursing care for ten minutes before connection, during the dialysis session and ten minutes after disconnection from dialysis machine three times per week for two successive weeks. **Results**: The acetate groups had experienced many complications rather than bicarbonate. There was a significant statistical difference between both groups with (p value=0.001). The complications developed where, hypotension, chest pain, dysrhythmia, muscle cramps, nausea, vomiting, headache, pruritus. **Conclusion**: Nursing care reduces complications for both groups acetate and bicarbonate dialysis documented lesser complications in bicarbonate than acetate group. **Recommendation:** Replication of this research on a larger probability sample acquired from different geographical areas in the Arab republic of Egypt.
[Naglaa Elrashedy, Warda Mohammed, Mona Mohammed, Mervat Abdel-Aziz and Maher Abd El Naser. **Effect of Nursing guidelines to reduce Complications of Acetate and Bicarbonate Solutions during Hemodialysis among Acute Renal Failure Patients, Assuit University Hospital.** *Life Sci J* 2014;11(2):41-54]. (ISSN:1097-8135). http://www.lifesciencesite.com. 6

Key words: complications, acetate solution, bicarbonate solutions, hemodialysis and acute renal failure patients.

1. Introduction

Critically ill patients with acute renal failure (ARF) have a longer length of hospital stay and more complications. ARF may occur in the critically ill patient, the risk of death rises dramatically. The mortality rate is very high. Patients with ARF often have associated multiple organ dysfunction syndrome (MODS) and have more complex illnesses and more critical care patients are receiving dialysis therapies in the critical care unit Typically, a patient is not admitted to the critical care unit with a diagnosis of ARF alone; there is always coexisting hemo-dynamic, cardiac, pulmonary, or neurologic compromise. **(1)**

Hemodialysis is a highly efficient method of removing excess water and solutes and waste product such as urea, creatinine, and toxins from the body. The patient's blood is passed across a semi permeable membrane contained in the dialysis hemofilter. The most dangerous complications during hemodialysis is hypotension, bleeding, clotting, disequilibrium syndrome, infections, electrolytes disturbances, acid base disturbance, coagulation abnormalities. **(2)**

The **critical care nurse's** role is very important during the dialysis session by assessing, monitoring, and evaluating fluid balance during the hemodialysis session. The critical care nurse also monitors blood pressure, pulse, weight, fluid intake and output, tissue turger, central venous pressure also help determine cardiovascular fluid overload**;** reviews of patient history and clinical findings, and response to dialysis treatment, frequent blood sample for laboratory examinations. The alert critical care nurse are in a good position to confront these complications by assessing and monitoring the patient's response to hemodynamic stability during hemodialysis. The critical care nurse who is providing daily care for the patients receiving hemodialysis focuses on the early detection and prevention of physiological changes and complications noted in the patients during hemodialysis and provision of proper management in its surt of the time, which will be cost effective **(3)**

2. Patients and Methods

2.1.Aim of the study

The current study was aimed to evaluate the effect of nursing guidelines on complications developed for hemodialyzed acute renal failure patients on acetate and bicarbonate solution

2.2. Research hypothesis:-

What is the effect of nursing guidelines on complications developed for hemodialyzed acute renal failure patients on acetate and bicarbonate solution ?

2.3.Research design

Quasi experimental research design has been utilized in this study.

2.4.Setting:

This study was carried out in hemodialysis unit and medical, trauma, coronary, intensive care units at Assiut University Hospital

2.5. Sample:

Sixty adult male and female critically ill patients with acute renal failure who are admitted to the hemodialysis unit for the first time and ready to participate in this study. The patients matched and divided into thirty in each group.

2.5.1. Matching criteria were considered**,** age and sex

3. Content validity: the tools were tested for content related validity by jury of 6 specialists in the field of critical care nursing and internal medicine from Assiut University and Cairo University, and the necessary modifications were done.

4. Pilot study:

A pilot study was conducted on 30 patients after explain the nature and purpose of the study 5 patients with acute renal failure to test the feasibility and applicability of the tools. The necessary modifications are required. These necessary modifications were done and the pilot study patients were excluded from the actual study.

5. **Protection of human rights**:

An Official approval was obtained from hospital administrative authority to collect the necessary data after explanation of the aim and nature of the study. Patients' anonymity and confidentiality were ascertained, patients' was maintained and voluntary participation and right to refuse to participate in the study were emphasized to the patients. Written consent was obtained from patients who are welling to the study.

2.6. Study tools

Two tools were developed by researcher and used to collect the data in this study.

2.6.1. Tool one: "**Personal and medical data sheet"**

It used to assess the studied patients regarding socio-demographic and medical data. This tool comprises four main parts.

2.6.1.1. Part I: Personal data: It consist of demographic data as (patients name, age, sex,, date of admission, date of discharge and types of ICU).

2.6.1.2. Part II: Medical data related to machine, dialysate fluids and dialyzer type:

This part was consist of the types of machine, the types of dialyzer, the types of dialysate fluid, sodium conductivity, blood flow rate of the pump, heparin dose, time of dialysis session, type of intravenous solution for saline or glucose.

2.6.1.3. Part III:"Physiological parameters"(before, during, after) dialysis session:

It was consist of two weeks, each week consist of three session, each session consist of 4 items that included predisposing factors for acute renal failure, vital signs (temperature, respiration), hemodynamic parameters as (blood pressure, heart rate, stroke volume, cardiac out put and peripheral resistance).

2.6.1.4.Part IV: **"Laboratory test results"**

This part was used to assess the selected hematological studies, as (renal function test, prothrombin time and thromboplastin time)

2.6.2.Tool two: "Hemodialysis complications assessment sheet during dialysis session"

It used to assess the studied patients during hemodialysis sessions for (six dialysis sessions). This tool was used to cover all signs and symptoms of complications that might develop during hemodialysis session, it was consist of 11 items as hypertension, hypotension, headache, muscle cramps, chest pain, cardiac dysrhythmia, nausea, vomiting bleeding vascular access infection, pruritus and headache, during the hemodialysis session.

6. Procedure:

6.1. Preparatory phase: which was conducted over a period of eighteen months starting from January 2011 till August 2012 because the rate of attrition.

- During this phase the researcher explain the nature and purpose of the study to the health team member in hemodialysis unite.
- The researcher firstly was followed the patient in intensive care unit (ICU) to interview with the patient about the disease process and explain the important and purpose of hemodialysis before the first dialysis session.
- During this phase the researcher was used to assess and give nursing care for the acute renal failure patients who receive Acetate solution and patients who receive bicarbonate solution
- The researcher was use**d** part I in tool on**e** for observation and reviewing the patient's sheet for

personal data and documented this data in part I tool one.

- Also the researcher was assess the patient`s laboratory tests in ICU before the first dialysis session as complete blood picture, renal function tests and documented that in part IV in tool one.

6.2.Implementation phase This was done by the researcher were followed the patients ten minutes before connected with dialysis machine in dialysis unite every dialysis session, during dialysis session (four hours) and ten minutes after disconnection from dialysis machine, follow up for two weeks (six dialysis sessions) for compared between the both groups.

- The researcher was used part III in tool one to monitor and documented the vital signs and hemodynamic status every half hours before ten minute from connected before the first time of dialysis session, during the dialysis session and ten minutes after disconnection.
- The researcher was used part III in tool one to measured cardiac out put(C.O.P) by equation C.O.P = End systolic pressure – End diastolic pressure. Stroke volume = C.O.P **X** heart rate[(4)]
- The researcher was used part III in tool one to measured the total peripheral resistance (TPR) which are recording before and after dialysis session by using equation TPR = (Mean arterial pressure MAP _ Mean venous pressure (C.V.P)÷ cardiac out put(C.O.P). MAP = [(2 × diastolic pressure) + (systolic pressure) ÷ 3}.

6.3.Evaluation phase: The researcher was tool two for observing the hemodialysis complications or signs and symptoms that the patients complain during the dialysis session as (hypertension, hypotension, headache, muscle cramps, chest pain, cardiac dysrhythmia, nausea, vomiting bleeding vascular access infection, pruritus and headache.

- All blood samples was take and documented in part IV in tool one at first and third dialysis session of first week and third dialysis session from second week before and after dialysis session with two hours in intensive care unite.
- Data collection phase of the study took approximately 18 montths started from December 2010 till August 2012.

Statistical design

Data was collected and analyzed by computer programmed SPSS (ver.16).Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for qualitative variables. Qualitative variables were compared using chi-square test to determine significance for non parametric variables-test used to determine significance for numerical variables. Independent samples t-test was used to compare the values of the mean score between the acetate and the bicarbonate groups. Paired test used to compare between before and after each group (≠). The critical value of the tests "*P*" was considered statistically significant when *P* less than 0.05

7. Results

7.1. Table 1: Shows that, the mean and standard deviation of **age** of the acetate group (G1) and bicarbonate group (G2) was found to be (41.9±10 and 38.6± 13.7) respectively. There was on statistical differences between the both group. Concerning **the gender** of the sample, the highest percentage of the two groups (36.7% and 50%) in G1 and G2 respectively were males while(63.4% and 50%) in G1and G2 were female. There was on statistical differences between the both group.

7.2. Table 2: shows that **body temperature**. There was no statistical significant differences was found between the both groups and between the two weeks. The **respiratory** rate in G1 had increase in respiratory rate and there were highly significant differences between the both groups in this respect with (*p* value =0.007 and 0.004) in the two weeks respectively. Regarding **heart rate** in G1and G2 after dialysis session with mean and standard deviation is (73.5±12 and 85.3± 4.3) respectively in the second week. While in group II shows decrease in heart rate after dialysis session but with in normal. There were highly statistical significant differences between the both groups with (*p* =0.002 and 0.001) in the two weeks respectively.

Concerning the systolic and diastolic blood pressure in G1 had decrease in blood pressure after dialysis session with mean (92.3±21.2 and 58.5±10.7) respectively. But in G2, normal systolic and diastolic blood pressure after dialysis in 1nd week with mean (105±28 and80.1±16.6) respectively. There were highly statistical significant differences between the both groups with (*p* =0.001).

7.3. Figure 2: Regarding systolic and diastolic blood pressure in G1 had decrease in blood pressure during dialysis session with mean (89.1±21.2 and 66.4±10.7) respectively. But in G2, normal systolic and diastolic blood pressure after dialysis in 2nd week with mean (99.8±28 and69.3±16.6) respectively. There were highly statistical significant differences between the both groups with (*p* =0.001).

Regarding **body temperature** during hemodialysis, There was no statistical significant differences was found between the both groups and between the two weeks. The **respiratory** rate had increase in respiratory rate. There was highly statistical significant differences between the both groups with (*p* =0.001and 0.046) in the both groups respectively. **Concerning the heart rate** had increase in heart rate in G1 during session. While in G2 had normal heart rate. There was a highly statistical significant

differences between the both groups and the two weeks with (p =0.001).

7.4. Table 3: Shows that, decrease in **stroke volume** (S.V) in G1. While in G2 had

decrease but still in normal range after dialysis session in the both weeks. There was highly statistical significant difference between the both groups and between the two weeks in this respect with (p =0.015 and 0.001) and before and after each group with (p =0.001 and 0.006). **Regarding Cardiac out put** decrease less than normal range in G1 and decrease but with in normal range in G2. There was statistical significant difference between the both groups in this respect with p value (0.044, 0.010) and before and after in G1 with (p =0.001and 0.038). Concerning **total peripheral resistance** was decrease after dialysis in G1, but in G2 increase after dialysis session. There was a highly statistical significant difference between the both groups in this respect with (p = 0.019 and 0.001) and between before and after in G1 with (p =0.001).

7.5.Table 4: shows that**,** decrease in stroke volume and cardiac out put in G1 during dialysis session with mean(39.2 ± 11.1 and 3824.8± 821.2) in the first week. There were a highly statistical significant difference between the both groups in relation to stroke volume and cardiac out put during hemodialysis session with (p =0.001)

7.6.Figure3: revealed that **central venous pressure** deceased after dialysis session in G1 more than G2 with (60% and 16.6%) respectively in 1st week and there a statistical significant difference between both groups with (p =0.002).

7.7.Table 5: Shows that the two groups were slight decreased in all values of renal function tests but still abnormal values. There were a highly significant statistical difference was found between before and after two weeks and between the studied groups in these respects with (p = 0.037, 0.001 and 0.013) respectively.

7.8. Table 6: Presented that, G1 had experienced decreased in **partial arterial oxygen** (PO_2) after hemodialysis session with mean and standard deviation (77.1±3.1). But in G2 had normal partial oxygen. There was a highly significant statistical difference was found between the both groups with (p = 0.001). Regarding the level of **blood PH** had decreased after dialysis session in G1with mean and standard deviation (7.31±0.04 and 7.30±0.06) in the two weeks respectively. While in G2 had experienced normal PH with mean and standard deviation (7.42±0.07). There was a highly significant statistical difference between before and after G2 with (p =0.001).

As regarding the level of **bicarbonate (HCO_3)** in blood had increased after dialysis session in G1 with mean and standard deviation (27.3±2.2 and 26.9±2.7) in the two weeks respectively. While in G2 had normal HCO3 after session. There was a highly significant statistical difference was found between before and after each group with (p =0.001). Concerning **carbon dioxide** had increased after dialysis session in G1, but in G2 had normal range after session. There was a highly significant statistical differences between the studied groups in 2nd week with (p = 0.001).

7.9.Table 7: Shows that, normal **potassium** in G1 while increase in potassium level in G2 after dialysis session. There were a statistical significant difference between both groups with (p =0.001)**.**Regarding **sodium** increased in the G2 after session. With a statistical significant difference between both groups with (p =0.001). **decreased in phosphate** and **magnesium** were found in G1after session while in G2 **increased in calcium and increased in phosphate level** and **magnesium** was found after dialysis.

7.10.Table 8: shows that (63.3% and 26.6%) in G1 and G2 respectively had experienced **hypotension**. There was a significant statistical difference between the studied groups with p value =(0.019). (90.3%and 56.6%) in G1and G2 respectively had experienced **headache**. There was a significant statistical difference between the studied groups with p value =0.047

Table (1): Characteristics of the acetate and bicarbonate group in relation to age, gender and types of ICU.

Types of solutions / Variables	Acetate solution G1		Bicarbonate solution G2	
	N	%	N	%
1-Age groups				
- 20< 29 years	5	16.6	7	23.3
- 30< 39 years	13	43.3	12	40.0
- 40 < 49 years	7	23.3	5	16.6
- 50 < 60 years	5	16.6	6	20
- The mean &St. D of age	41.9±10.0		38.6±13.7	
2- Gender				
-Male	11	36.7	15	50
-Female	19	63.3	15	50
3- Types of ICUs				
-Medical (ICU)	18	60.0	11	36.7
-Medical reception (ICU)	8	26.7	2	6.7
-CCU	4	13.3	0	0.0
-Obstetric (ICU)	0	0.0	10	33.3
-Trauma (ICU)	0	0.0	7	23.3

Acetate group (G1), Bicarbonate group (G2)

7.11.Figure 4: Shows that, (26.6% and 16.6%) in G1 and G2 respectively had experienced **hypertension**. There was no significant statistical difference between the studied groups. (63.3%and 40%) in G1and G2 respectively had experienced **hypotension**. There was a highly significant statistical difference between the studied groups with p value 0.048. (23.3%and 10%) in G1and G2 respectively had experienced **chest pain and cardiac dysrhythmias.** There was no significant statistical difference between the studied groups. (36.6%and 30%) in G1 and G2 had **muscle cramp**.

There was no significant statistical difference between the studied groups.

(10%and 16.6%) in G1 and G2 had experienced **bleeding.** There was no significant statistical difference between before and after each group. (76.6% and 70%) in G1 and G2 had experienced **nausea**. There was no significant statistical difference between the studied groups**.** (50%and 40%) in G1 and G2 respectively had **vomiting**. There was no significant statistical difference between the studied groups. (86.7% and 63.3%) in both groups respectively had experienced **headache**. There was a highly significant statistical difference between the studied groups with (p =0.038). 16,6% and 23.3% in G1and G2 respectively had vascular **infection**. (36.6% and 13.3%) in the studied groups had experienced **pruritus**. There was a significant statistical difference was found between the studied groups with (p =0.049).

7.12.Figure 5: revealed that, 73.3% and 60% in G1, G2 respectively were still on dialysis in G1 more than G2. While in both groups had **improved** respectively by (26.6%and 40%). There was no significant statistical difference between the studied groups.

Table 2: Comparison between the both groups in relation to vital signs before and after dialysis session

Vital signs	**Acetate solution (mean + SD) G1**			**Bicarbonate solution (mean + SD) G2**		
1-Temperature	**Before 10 min**	**After 10 min**	***P.* value**	**Before 10 min**	**After 10 min**	***P.* value**
- 1st week	37.4 + 0.3	33.7 + 7.5	0.001	37.5 + 0.3	37.3 + 1.8	0.989
-2nd week	37.4 + 0.2	36.4 + 3.8	0.155	38.5 + 7.4	37.3 + 0.2	0.378
***P.* value**	0.986	**0.002**		0.462	0.998	
2- Respiration						
- 1st week	18.2 + 2.1	21.3 + 3.7	**0.001**	16.9 + 2.4	20.9 + 3.4	**0.001**
-2nd week	18.5 + 2	22.2 + 3.7	**0.001**	17 + 2.5	20.5 + 4.3	**0.001**
***P.* value**	0.241	0.120		0.811	0.499	
3- Heart rate						
- 1st week	81.2 + 12	81.9 + 16	0.626	104.8 + 10.6	89.5 + 16.1	0.354
-2nd week	73.5 + 9.7	73 + 11.5	0.715	100.9 + 14.4	85 + 14.2	0.896
***P.* value**	0.001	0.001		0.002	0.050	
4-Blood pressure						
- 1st week	163.1 + 7.7/ 96.6 + 4.7	120.6 +20.7/ 84.5 + 11.9	**0.001**	92.3 + 21.2/ 58.5 + 10.7	105 + 28/ 80.1 + 16.6	0.051 0.359
-2nd week	162 + 7.9/ 98.9 + 3	115.3 +19.3/ 86.5 + 10.2	**0.001** **0.001**	89.1 + 24.8/ 66.4 + 13.8	99.8 + 24.1/ 69.3 + 14.3	**0.001**
***P.* value**	0.001	0.227		**0.036**	0.457	

Table 3: Comparison between the both groups in relation to vital signs during dialysis session

Vital signs	**During dialysis session**		**T. test**
	Acetate G1	**Bicarbonate G2**	
1-Temperature			
- 1st week	37.3 + 0.2	37.5 + 0.2	**0.002**
-2nd week	37.2 + 0.2	37.4 + 0.2	**0.002**
***P.* value**	**0.057**	**0.057**	
2- Respiration			
- 1st week	25 + 2.9	19.4 + 2.6	**0.001**
-2nd week	23.3 + 2.1	22.2 + 2.5	**0.070**
***P.* value**	0.380	0.675	
3- Heart rate			
- 1st week	101.8 + 11.7	90.4 + 11	**0.001**
-2nd week	99.6 + 7.6	84 + 14.1	**0.001**
***P.* value**	**0.001**	**0.001**	

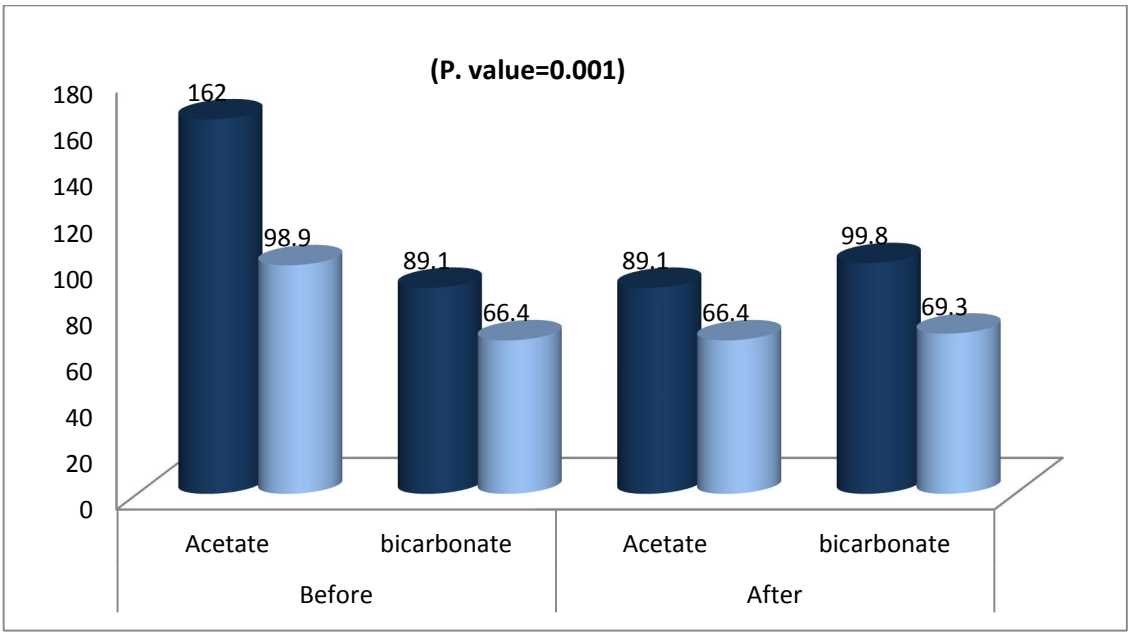

Figure (1): Demonstration the studied groups in relation to the mean and standard deviation of systolic and diastolic blood pressure before and after dialysis session in 2nd week.

Table 4: Comparison between the both groups in relation to hemodynamic before and after dialysis sessions.

The both groups / Item	Acetate group G1		Bicarbonate group G2		*P.* value
	Before 10 min	After 10 min	Before 10 min	After 10 min	
1-Stroke volume					
-1st week	65.2 ± 6.1 ≠	38.4 ±11.3 ≠	48.1 ± 11 ≠	43.7 ± 13.1 ≠	**0.015****
- 2nd week	63.2 ± 6.9 ≠	40 ± 13.7 ≠	52.8 ± 12.5 ≠	43.2 ± 14 ≠	**0.001****
***P.* value**	**0.040****	**0.009****	**0.001****	0.826	
2- Cardiac out put					
-1stweek	5284.7 ± 102 ≠	3996.4 ± 946 ≠	5308.8 ± 670 ≠	4383.3±437.1≠	**0.044****
- 2nd week	4466.2 ± 860.4 ≠	3856.2 ± 981 ≠	4820.9 ± 771 ≠	4412.4 ± 439 ≠	**0.010****
***P.* value**	**0.001****	**0.038****	0.268	0.965	
3- total peripheral resistance					
-1stweek	0.027 ± 0.005 ≠	0.031 ± 0.005 ≠	0.034 ± 0.009	0.031 ± 0.007	**0.019****
- 2nd week	0.029 ±0.007 ≠	0.030 ± 0.006 ≠	0.037 ± 0.006	0.029 ± 0.008	**0.001****
***P.* value**	**0.002****	**0.003****	0.781	0.394	

Table 5: Comparison between the both groups in relation to hemodynamic during dialysis session

The both groups Item	During hemodialysis session		T. test
	Acetate G1	Bicarbonate G2	
1- Stroke volume			
1st week	59.3 + 6.6	46.2 + 11.1	0.001
2nd week	60.3 + 7.8	48.4 + 11.7	0.001
P. value	0.361	0.189	
2- Cardiac out put			
1st week	4824.8 + 821.2	4090.4 + 747.4	0.001
2nd week	4197.2 + 448.4	3892.2 + 433.5	0.001
***P.* value**	0.001	0.031	

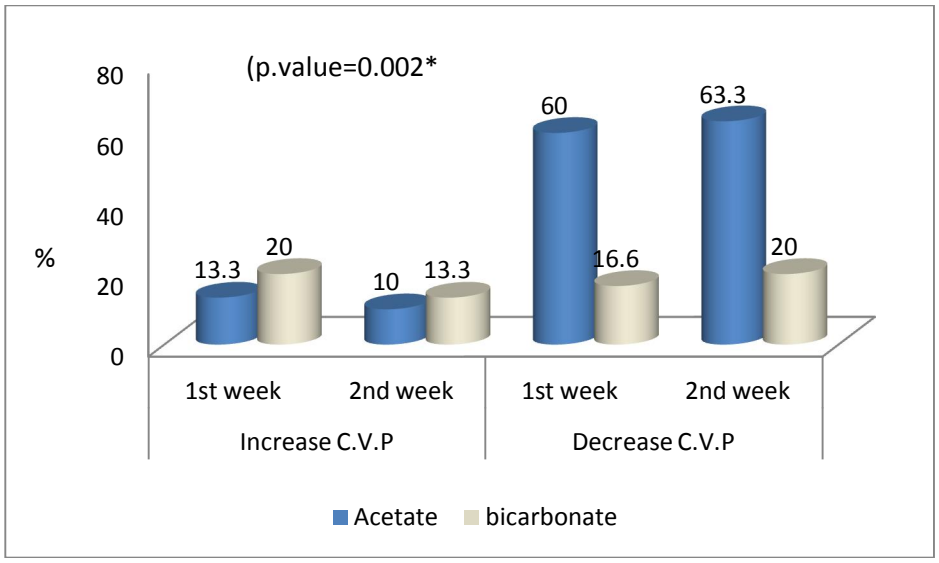

Figure (2): Percentage distribution to central venous pressure after hemodialysis session between the studied groups through two weeks.

Table 6: Comparison between the studied groups in relation to the mean and standard deviation of renal function tests before and after dialysis

Renal function tests	Acetate group G1		Bicarbonate group G2		T. test
	Before	After	Before	After	
1-Blood urea nitrogen **-1st week** **-2nd week**	33.18±12.94 ≠ 20.95±8.82	25.66±13.74 ≠ 18.03±5.82	28.72±11.25 ≠ 19.72±11.4	20.69±11 ≠ 11.04±13.31	**0.041**** **0.037**
***P* value**	**0.001***	**0.001***	**0.001***	**0.001***	
2-Serum urea **-1st week** **-2nd week**	44.7±8.6 67.95±89.3 ≠	40.42±6.46 33.94±8.93 ≠	36.47±7.64 28.07±15.04 ≠	34.27±5.39 18±8.9 ≠	**0.001**** **0.001**
***P* value**	**0.001***	**0.001***	**0.001***	**0.001***	
3-Serum creatinine **-1st week** **-2nd week**	363.65±204 ≠ 252.13±145 ≠	261.05±114 ≠ 194.53±87.8 ≠	276.8±156 ≠ 204.96±109 ≠	205.24±91 ≠ 161.63±69 ≠	0.093 **0.013**
***P* value**	**0.001***	**0.001***	**0.001***	**0.001***	

Table 7: Comparison between the studied groups in relation to the mean and standard deviation of acid base disturbances before and after dialysis sessions through two weeks.

The two groups / -Arterial blood gases	Acetate group G1		Bicarbonate group G2		T. test
	Before	After	Before	After	
1-PO2 **-1st week** **-2nd week**	149.4±4.5 ≠ 159.4±3.2 ≠	77.1±3.1 ≠ 79.1±2.1 ≠	187.2±2.2 ≠ 173.5±1.2 ≠	121.6±7.4 ≠ 119.3±8.2 ≠	**0.001*** **0.001***
***P* value**	0.325	0.241	0.006	0.402	
2-Blood (PH) **-1st week** **-2nd** week	7.39±0.04 ≠ 7.36±0.07 ≠	7.31±0.09 ≠ 7.30±0.06 ≠	7.34±0.01 ≠ 7.34±0.03 ≠	7.42±0.07 ≠ 7.36±0.02 ≠	**0.001*** **0.004***
***P* value**	0.046**	0.315	0.999	0.001**	
- Bicarbonate (HCO_3) **-1st week** **-2nd** week	22.33±2.01 21.43±2.05	27.3±2.28 26.97±2.7	27.17±1.8 ≠ 28.7±2.42 ≠	21.4±2.44 ≠ 24.25±4.45 ≠	**0.001*** **0.001***
***P* value**	0.091**	0.001**	0.007**	0.001**	
4-Carbone dioxide(CO_2) **-1st week** **-2nd** week	41.4±4.18 40.37±4.69 ≠	46.9±5.7 44.87±7.44 ≠	48.93±2.85 ≠ 46.83±5.66	41.2±6.08 ≠ 44.37±6.51	0.134
***P* value**	0.372	0.020**	0.074**	0.474	**0.001***

Table 9: Comparison between the studied groups in relation to the mean and standard deviation of electrolytes disturbances before and after dialysis sessions.

-Electrolytes	Acetate groups G1 N=30		Bicarbonate group G2 N=30		T. test
	Before	After	Before	After	
1-potassium -1st week -2nd week	3±0.83 3.64±1.14	3.61±0.84 ≠ 2.34±0.96 ≠	3.47±2.4 3.76±1.32	6.3±0.72 ≠ 5.6±0.72 ≠	**0.001**** **0.001**
P value	0.015**	0.001**	0.564	0.003**	
2-Sodium -1st week -2nd week	134.7±4.7 ≠ 137.9±6.38 ≠	137.2±6.43 ≠ 142.37±4.5 ≠	135.53±6.1 ≠ 135.16±1.5 ≠	148.87±5.65 ≠ 149.86±.01 ≠	**0.001**** **0.001**
P value	**0.031****	**0.001****	0.763	0.341	
3-Calcium -1st week -2nd week	4.2±0.88 ≠ 5.18±2.11 ≠	2.2±1.09 ≠ 2.8±1.86 ≠	3.93±1.18 5.33±2.56	5.4±1.02 ≠ 6.8±1.84 ≠	**0.001**** **0.001**
P value	0.022*	0.132	**0.008****	**0.001****	
5-Magnesium 1st week -2nd week	2.62±0.81 2.73±0.82	1.4±0.45 ≠ 1.3±0.49 ≠	2.2±0.63 2.6±1.06	2.6±0.37 ≠ 2.7±0.73 ≠	**0.032**** **0.045**
P value	**0.031****	**0.001****	0.763	0.341	

Table 10: Effect of nursing care on complications for both groups during hemodialysis sessions in first weeks

The complications	Acetate group G1				Bicarbonate group G2				*p*. value
	Present		Absent		Present		Absent		
	No	%	No	%	No	%	No	%	0.231
1-Hypertension	8	**26.6**	22	74.4	5	**16.6**	25	84.4	
2- Hypotension	19	**63.3**	11	36.7	8	**26.6**	22	73.3	**0.019***
3-Chest pain	7	**23.3**	23	76.6	3	**10**	27	90	0.165
4-Cardiac dysrhythmias	7	**23.3**	23	76.6	3	**10**	27	90	0.165
5-Muscle cramp	11	**36.6**	19	63.3	9	**30**	21	70	0.538
6-Bleeding	3	**10**	27	90	5	**16.6**	25	83.3	0.477
7-Nausea	23	**76.6**	7	23.3	21	**70**	9	30	0.559
8-Vomiting	15	**50**	15	50	12	**40**	18	60	0.436
9-Headach	27	**90**	3	10	17	**56.6**	13	43.3	**0.047***
11-pruritus	11	**36.6**	19	63.3	7	**23.4**	23	76.6	0.259

Chi-square test; **highly statistical significant difference ($P < 0.05$)

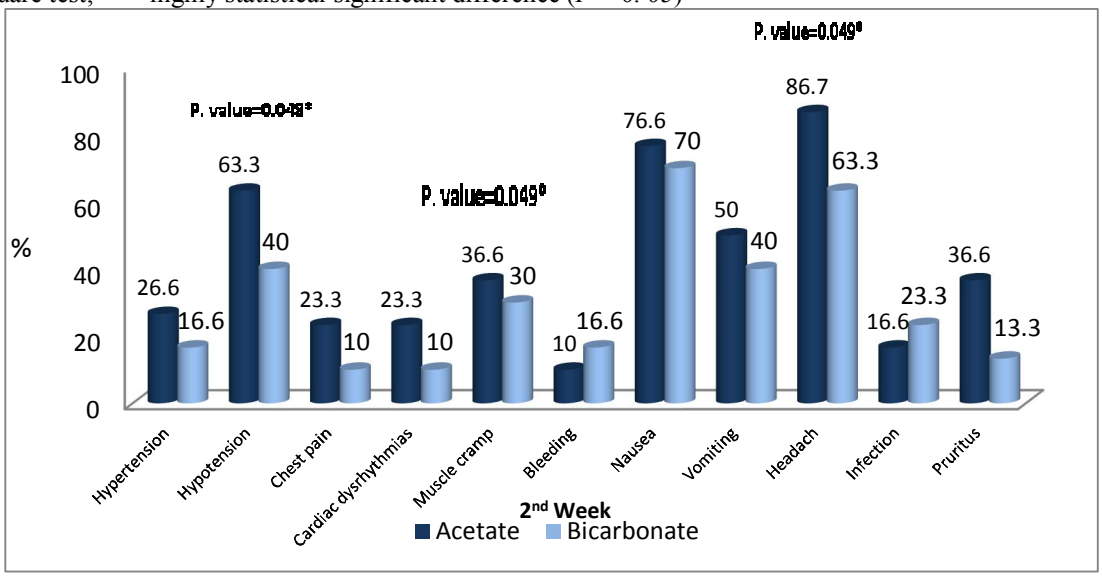

Figure (3): Effect of nursing care on complications during dialysis sessions between the studied groups in 2nd week.

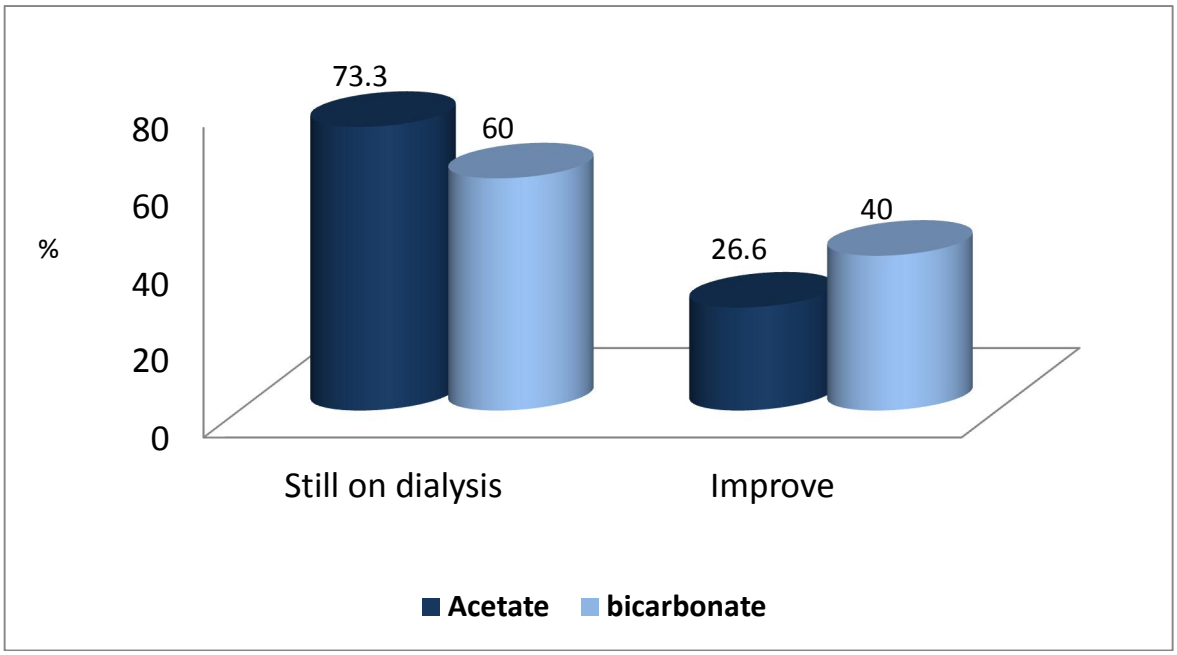

Figure (4): Percentages distributions to progress of patient`s condition between the studied groups after two weeks.

8. Discussion

The critical care nurse are in a good position to confront these complications by assessing and monitoring the patient's response to hemodynamic stability during hemodialysis. the critical care nurse is providing daily care for the patients receiving hemodialysis focuses on the early detection and prevention of complications noted in the patients during hemodialysis and provision of proper nursing management [(4)]

The present study presented that the majority of both groups were in **age group** 40 to less than 60 years with mean and standard deviation of age (41.9±10 and 38.6±13). This can be attributed to the higher exposure of younger male adult to trauma, systemic hypertension and renal stone related to some metabolic error than female. While females were more exposure to post partum hemorrhage (prerenal ischemia). This is disagreement with **Jonathan *et al.,*** [(2)] who reported that, the age more than seventy years old**.** On other hand, **Gold man *et al.,*** [(5)] who indicated that, the age more than fifty years old.

Regarding the predisposing factors for acute renal failure, the present study revealed that, more than thirty of the sample in acetate group (G1) were experienced acute nephritis& chronic renal stone, septic shock, lupus nephritis & hypertension, while in bicarbonate group (G2) were experienced multiple trauma, post partum hemorrhage and renal stone& nephritis. This is in line with **Malhis *et al.,*** [(6)] whom reported that, any ischemic or toxic causes at the site of the nephron places the patients at risk of ARF as hemorrhage and sever dehydration. Any obstruction in the flow of urine may lead to post renal as chronic renal and ureter stone causes ARF.

Regarding the vital signs in hemodialysis, the findings of current study revealed that the majority of the both groups had normal range of **temperature** before, during and after hemodialysis session. This finding attributed to the all patients had taken antibiotics medications. There was no statistical significant differences between the both groups. This agreement with **Gabutti *et al.,*** [(1)] who reported that the dialysate solutions had not any effect on the patients temperature. On the opposite, **Shoichiro *et al.,*** [(7)] who reported that acetate hemodialysis may evoke increase in temperature post dialysis session.

Concerning the respiration, the findings of current study revealed that the majority of the both groups had dyspnea and **tachypnea** in acetate group during and after dialysis session. This finding attributed to the most of the patients had hypotension during dialysis session. There was a highly statistical significant differences between the both groups with p (0.007) and (0.004). This finding on line with **Gabutti *et al.,*** [(1)] who proved that in acetate hemodialysis may associated with tachypnea and shortness in breathing due to hypotension during hemodialysis session.

As regarding the heart rate, the findings of current study reported that the majority of the patients had normal heart rate before and after dialysis session in acetate group While in bicarbonate group had experienced bradycardia after hemodialysis session but with in normal. There was a statistical significant differences between the both groups with p (0.001 and 0.002). This finding attributed to the most of the patients had hypotension during dialysis session. This finding agreement with **Saitos *et al.,*** [8] who revealed that, tachycardia during and after dialysis session. Another point of view, **Gabutti *et al.,*** [1] reported that, in acetate and bicarbonate had normal heart rate during dialysis session. In this respect **Gonce *et al.,*** [4] recommended that the critical care nurses should be close observation the patients during the hemodialysis session and monitoring the vital signs every half hours.

Concerning the blood pressure, the findings of current study reported that the majority of the patients in acetate group had hypotension during and after dialysis session. While in bicarbonate group had normal blood pressure during hemodialysis session. This finding attributed to disease process and the most of the patients in acetate group had received intravenous saline and increase sodium conductivity to 145 mmol/min and the acetate dialysate had vasodilator. There were a statistical significant differences between the studied groups and before and after dialysis in the each group with *p* (0.001). This finding agreement with **shoichiro *et al.,*** [7] and who reported that, in acetate dialysate cause hypotension during and post dialysis session.

Regarding the stroke volume and **cardiac out put**, the findings of current study reported that the majority of the patients in the acetate group had decrease in stroke volume and cardiac out put during and after dialysis session. But in bicarbonate had normal stroke volume and cardiac out put. This finding attributed to the most of the patients had hypotension in the acetate group during and after dialysis session. There were a highly statistical significant differences between before and after each group and between the studied groups with *p* value (0.015 and 0.001) and *p* value = 0.001 during dialysis session. This finding agreement with **Heitor *et al.,*** [10] whom revealed that decreased in stroke volume and cardiac out put in acetate dialysis.

Concerning the total peripheral resistance, the findings of current study reported that the majority of the patients in acetate dialysis had decrease in total peripheral resistance, but increase in bicarbonate dialysis. This finding attributed to hemodynamic changes in the both groups. There were a statistical significant differences between the both groups with p (0.019 and 0.001) in 1st and 2nd weeks respectively. This finding agreement with **Gabutti, *et al.,*** [1] whom revealed that decrease in total peripheral resistance in acetate dialysis, but increase in bicarbonate dialysis. This finding disagreement with who reported [10] that decrease in total peripheral resistance in bicarbonate dialysis.

As regard, the central venous pressure after dialysis session**,** the findings of current study reported that the most patients in the acetate group had decrease after dialysis session. While low percent in bicarbonate group had increased in central venous pressure after dialysis session. There was a highly statistical significant differences between the studied groups with *p* value (0.002). These findings attributed to increase the weight after dialysis session in bicarbonate dialysis related to high level of sodium. This agreement with **Gabutti *et al.,*** [1] who reported that the central venous pressure had decreased in acetate dialysis. In this respect **Gonce *et al.,*** [4] recommended that the critical care nurses should be measured the central venous pressure before and after dialysis session for evaluation the fluid volume status.

Regarding the renal function tests, the findings of current study reported that the majority of the patients in the both groups were slight decreased in all values of renal function tests but still abnormal values after dialysis session. There were a highly significant statistical difference was found between before and after dialysis session and between each groups with p (0.037, 0.001 and 0.013) in 2nd week. This finding agreement with **Basile *et al.,*** [11] and **John, and Todd,** [12] who reported that the majority of the patients in the acetate and bicarbonate group were slight decreased in all values of renal function tests after dialysis session. In this respect, **Gonce *et al.,*** [4] reported that the critical care nurses should be taken the blood sample before and after dialysis session for renal function tests to follow the progress of the patient's condition.

Concerning acid base disturbances, the findings of current study reported that the majority of the patients in acetate group was experienced **hypoxemia** after dialysis session, but in bicarbonate group, thirty percent had experienced hypoxemia after dialysis session. This finding attributed to the most of patients in acetate group had sever hypotension during and after hemodialysis session. There was a highly significant statistical difference was found between before and after each group with *p* (0.001). This finding agreement with **Kais *et al.,*** [13] who reported that acetate group was experienced hypoxemia during and after hemodialysis session due to carbon dioxide loss in the dialysate and increase oxygen consumption had derived from acetate metabolism.

Another point of view reported by **Gonce *et al.,*** [4] who recommended that the critical care nurse should monitoring the blood pressure every half hours

during dialysis session and manage the hypotension, also had taken blood sample before and after each dialysis session for interpretation arterial blood gas. The findings of current study reported that the majority of the patients in the both groups had experienced **acidosis** after dialysis session While in bicarbonate group had experienced low percent of patients with metabolic acidosis.There were a statistical significant differences between the both groups with p (0.001 and 0.004) 1st and 2nd weeks respectively.**Kais *et al.,*** [13] reported that blood pH significantly increased, changing from acidic to alkaline pH, with both modalities of hemodialysis. This finding agreement with and **Gabutti *et al.,*** [1] whom recommended that the use of acetate dialysis correct mild and moderate metabolic acidosis, but bicarbonate dialysis was used to correct sever metabolic acidosis.

Concerning the bicarbonate level, the findings of current study reported that alkalosis after dialysis session in acetate group. While in bicarbonate had alkalosis. There were a statistical significant differences between the both groups with p (0.001 and 0.001) 1st and 2nd weeks respectively This agreement with **Heitor *et al.,*** [10] who demonstrated that metabolic alkalosis resulting from bicarbonate dialysis.

Regarding the carbon dioxide, The findings of current study reported that the majority of the patients in the acetate group had experienced hypercapnia. While in bicarbonate had normal **carbon dioxide** after dialysis session. This findings attributed to hypoxemia and excessive demand of oxygen consumption and increase carbon dioxide in blood. There were a statistical significant differences between the both groups with p (0.001) in 2nd weeks. This findings agreement with **John and Todd,** [12] who reported that the acetate dialysis always associated with hypercapnea.

Regarding electrolytes disturbances, the findings of current study reported that the majority of the patients in group one was normal potassium level after dialysis session, but in group two was found **hyperkalemia** after dialysis session. There were a statistical significant differences between the both groups with *p* (0.001). This finding disagreement with **Heitor *et al.,*** [10] who reported that the bicarbonate dialysis was found hypokalemia, but in acetate group was experienced hyperkalemia.

Moreover, the findings of current study reported that **hypernatremia** was found in the bicarbonate group. This finding attributed to process of disease and excessive intravenous solution of saline in bicarbonate group. There were a statistical significant differences between the both groups with *p* (0.001).This disagreement with **Diamon,** [9] who reported that hypernatremia was found in the both groups. On the other hand, **Hla *et al.,*** [14] reported that in the bicarbonate associated with hypernatremia, but in acetate group was found hyponatremia.

Concerning phosphorus and magnesium, the findings of current study reported that the majority of the patients in acetate group was experienced hypophosphatemia and hypomagnesaemia after dialysis session. While in group two was experienced hyperphosphatemia and hypermagnesaemia was found after dialysis. There were a statistical significant differences between the both groups with *p* (0.001).This finding agreement with **Gabutti *et al.,*** [1] who reported that hypomagnesaemia can occur with acetate hemodialysis, but increase the level of magnesium in bicarbonate hemodialysis.

There were a statistical significant differences between the both groups with *p* (0.032 and 0.045) in 1st and 2nd weeks. **Moreover,** the findings of current study reported that the majority of the patients in bicarbonate group were found **hypercalcaemia,** but hypocalcaemia result from acetate dialysate solution. This finding agreement with **Yokoyama *et al.,*** [15]

Regarding the complications during hemodialysis session, the findings of current study reported that low percent from bicarbonate group had experienced **hypertension** more than acetate groups. There was no significant statistical difference was found between before and after the each group. This findings can attributed to bicarbonate increase in blood pressure, but acetate had induced hypotension, moreover, **Inrig *et al.,*** [16] who recommended that thirteen percent had interdialytic hypertension during hemodialysis and cause mortality in hemodialysis patients, also reported The fluid volume overloud and increase weight for 3 to 4 kg between two dialysis sessions cause hypertension, renal obstruction as renal stone or renal infarction also cause hypertension.

Regarding hypotension during hemodialysis session, the findings of current study reported that the majority of the patients had experienced hypotension in acetate group, but in bicarbonate group about thirty percent had experienced hypotension during dialysis session. This findings attributed to acetate consider vasodilator that induce hypotension. There was a statistical significant differences between the both groups with p (0.048).This agreement with **Santoro *et al.,*** [17] whom reported that acetate dialysis causes hypotension during hemodialysis session. In this respect **Shastri,** [18] who recommended that avoid taking any hypertensive drug before dialysis, avoid eating during dialysis, correction of anemia, use bicarbonate dialysate solution that increase in blood pressure to prevent hypotension. The critical care nurses should put the patient in trendelenburg position and then a bolus of intravenous hypertonic saline and

give sertraline in dose 50 to 100 mg per day as doctor order. Thus answer the first question.

Concerning chest pain and cardiac dysrhythmias, the findings of current study reported that thirty of the acetate group had experienced chest pain and cardiac dysrhythmias**,** but in bicarbonate group low percent had chest pain and cardiac dysrhythmias**.** There was no significant statistical difference was found between the studied groups. This findings attributed to hypotension episodes during dialysis session, electrolytes disturbances and hypoxemia that occur in acetate dialysis.

This agreement with **Buemi *et al.,*** [19] whom reported that bicarbonate hemodialysis is less arrhythmogenic. Continuous ambulatory ECG recording (Holter) is useful in detecting arrhythmia in dialysis patients**.** This findings on line with **Hamp *et al.,*** [20] who reported that during acetate dialysis the patients showed a frequent onset of arrhythmia. Whereas this symptoms was nonexistent during bicarbonate dialysis.

In this respect, Abbotti *et al.,* [21] recommended that nursing measures to prevent arrhythmias include the use of bicarbonate dialysate and careful attention to dialysate potassium and calcium levels. Use of zero potassium dialysate: should be discouraged because of arrhythmogenic potential, and potassium modeling may be useful.

Frequent ECG monitoring in patients on digitalis, intracellular potassium shifts during dialysis should be minimized. Serum digoxin levels should be regularly monitored and the need the drug regularly reassess. Every dialysis session the critical care nurse should be carefully any signs of dysrhythmia during dialysis session as chest pain, irregular heart rate and tachycardia. Then performing electrocardiograph (ECG) to early found dysrhythmias, if present the patient should be treated, in case of atrial fibrillation, B blockers, calcium channel blocker may be used for control [21]**.**

As regarding muscle cramps, the findings of current study revealed that the most of acetate group had experienced muscle cramps during dialysis session**.** While in bicarbonate group had low percent with muscle cramps during dialysis session. There was a significant statistical difference was found between the studied groups with p (0.049). This findings attributed to hypotension, electrolytes disturbances. This findings agreement with **Jonathan *et al.,*** [2] whom reported that the muscle cramps occur in acetate dialysis related to sever hypotension and ischemia for muscle that cause decreased in blood supply to the muscles, lead to muscle cramps during hemodialysis session.

In this respect **Morath *et al.,*** [22] reported that hypertonic glucose, saline and manitol may be administered in muscle cramps and nursing measures that can be taken to prevent cramps include avoidance of intradialytic hypotension and regular exercise. Administered of 320 mg quinine sulfate 2 hours before hemodialysis session lead to decrease muscle cramps.

Concerning of bleeding, the findings of current study revealed that low percent in the both groups had experienced bleeding signs. There was no significant statistical difference was found between the studied group**s** This attributed to coagulation medications as heparin**.** This agreement with **Galbusera *et al.,*** [23] who reported that seventeen percent had gastrointestinal bleeding, hemorrhagic stroke, subdural hematoma and intraocular hemorrhage. Another point of view by **Yixiong *et al.,*** [24] who recommended that the appropriate approach to preventing the progress of hemorrhage is administration of regional heparin during hemodialysis session.

As regarding nausea and vomiting, the findings of current study revealed that the majority of the both groups had experienced nausea and vomiting during dialysis session. There was no significant statistical difference was found between the studied group**s**.This finding attributed to hypotension, allergic reaction and electrolyte imbalances and hypotension. This findings agreement with **John *et al.,*** [12] whom reported that the frequency of nausea and vomiting associated with acetate dialysate more than bicarbonate dialysis.

Regarding the headache, the findings of current study revealed that the majority of the both groups had experienced headache during dialysis session. This findings attributed to hypotension, hypertension, low level of sodium. There was a significant statistical difference was found between the studied groups with p value=0.038. This findings agreement with **Jesus *et al.,*** [25] who reported that**,** the majority of the both groups had experienced headache during dialysis session and management of headache is correction of electrolytes disturbances and given analgesics as orders.

Concerning the pruritus, the findings of current study revealed that the most of the acetate group had experienced pruritus, but in bicarbonate was low percent had experienced pruritus This finding attributed to hypersensitivity reaction due to material of hemodialyzer membrane and dialysate solutions. There was no significant statistical difference was found between the studied groups. This finding agreement with **John *et al.,*** [12] who reported that acetate dialysate solution had experienced more than bicarbonate dialysis**.**

As regarding the prognosis of acute renal failure, the findings of current study revealed that the majority of the patients were increase number of dialysis session that means still on hemodialysis in

acetate groups more than bicarbonate. There was no significant statistical difference was found between group. This finding attributed to many complications in acetate group more than bicarbonate groups. This finding agreement with **Lameire, [26]** who reported that If there is not a significant return of renal function within 6 to 8 weeks this usually means that there is end-stage renal failure (ESRF) but, rarely, late recovery can occur. The findings of current study revealed that 114 patients had acute renal failure in dialysis unite in 2012 (**hospital record**), fifty hundred percent had died, and seventy hundred percent transformed to chronic renal failure, thirty hundred percent had improved, This on line with **Jonathan *et al.*, [2]** who reported that when acute renal failure is severe enough to need dialysis, in-hospital mortality is around 50%, and it may exceed 75% in the context of critically ill patients**.**

Conclusion and Recommendations

Based on the findings of the present study, it can be concluded that nursing care for reducing hemodialysis complications had experienced low complications in bicarbonate group than acetate group on hemodialysis with statistical significant differences between both groups. This study also showed that the bicarbonate group subjects had lower complications than acetate group during hemodialysis sessions as (hypotension, hypoxemia, metabolic acidosis, arrhythmias, nausea, vomiting and headache.

Based on the study findings, the following **recommendations** are suggested:

- Developing nursing strategies aiming at improving the quality of hemodialysis practices.
- Establishing a standardized nursing protocol for reduce hemodialysis complications for acute renal failure patients.
- Bicarbonate dialysate should be used in hemodialysis to reduce the complications during dialysis.
- Antihypertensive drugs should not be given before dialysis session to reduce hypotension episodes in acetate dialysis.
- Replication of this research on a larger probability sample acquired from different geographical areas in Arab republic of Egypt for generalization.

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1/13/2014