Journal of Kerbala University , Vol. 14 No.1 Scientific . 2016

The Effect of Acute Renal Failure on the Levels of Some Parameters

التأثير للفشل الكلوي الحاد على مستويات بعض المعايير الحيوية

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Abstract:

Acute renal failure (ARF) is defined as the rapid cessation of renal excretory function within a time of hours or days, accompanied by a rise in serum urea and creatinine, and accumulation of nitrogenous waste products in a patient whose renal function was previously normal. It is usually, but not always, accompanied by a fall in urine output. This study included 40 patients of acute renal failure from both sexes. The biochemical investigations carried were the renal function tests including determination of urea, creatinine, uric acid, sodium and potassium in serum. The results of the present study shows that the levels of urea, creatinine, uric acid and potassium were significantly higher in patients of acute renal failure in comparison with control group, P value was less than 0.05, it also other parameter sodium was non-significantly decreased in patients when compared with control individuals.

الخلاصة:

يعرف الفشل الكلوي الحاد بأنه توقف الكلية لوظائفها الافرازية خلال وقت ساعات او ايام, يرافقه ارتفاع في مصل اليوريا, كرياتينين وتراكم الفضلات النتروجينية التي تفرز عند المرضى الذين عملت كليتهم سابقا طبيعيا. وهو احيانا لكن ليس دائما, يرافقه فشل في طرح الادرار. هذه الدراسة شتملت 40 مريض بالفشل الكلوي الحاد من كلا الجنسين. التشخيص الكيمائي الحيوي من خلال كشوفات وظائف الكلية يشمل ايجاد كل من اليوريا, الكرياتنين, حامض اليوريك, الصوديوم والبوتاسيوم في مصل الدم. نتائج البحث اظهرت ارتفاع معنوي في كل من اليوريا, الكرياتنين, حامض اليوريك والبوتاسيوم عند مرضى الفشل الكلوي الحاد عند مقارنتهم مع مجموعة السيطرة, وكذلك المعيار الحيوي الصوديوم حيث ينخفض بشكل غير معنوي عند مرضى الفشل الكلوي الحاد عند مقارنتهم مع افراد السيطرة.

Introduction:

Acute renal failure (ARF) is the sudden interruption of kidney function from block, reduced circulation, or disease in the kidney tissue. usually reversible with treatment. Otherwise, it can growth to end-stage renal disease(ESRD) or chronic renal failure [1]. However, an increased serum creatinine, accumulation of other nitrogenous-based waste s, and a decline in urinary output are the hallmarks of ARF [2]. ARF is potentially reversible if the precipitating factors can be modified before permanent kidney damage has occurred. ARF is a common threat to patients in intensive care units, with a mortality rate ranging from 40% to 75% [3]. ARF represents a rapid decline in renal function enough to increase blood levels of nitrogenous wastes and impair fluid and electrolyte balance. It is a common threat to seriously ill persons in intensive care units, with a mortality rate ranging from 42% to 88%. Although treatment methods such as dialysis and renal replacement methods are effective in correcting life-threatening fluid and electrolyte illnesses, the mortality rate associated with acute renal failure has not changed substantially [4]. This perhaps is because acute renal failure is seen more often in older persons than before, and because it frequently is superimposed on other life-threatening conditions, such as trauma, shock, and sepsis. The most common indicator of acute renal failure is azotemia, an accumulation of nitrogenous wastes (urea nitrogen, uric acid, and creatinine) in the blood. In ARF the glomerular filtration rate (GFR) is decreased. As a result, excretion of nitrogenous wastes is reduced and fluid and electrolyte balance cannot be maintained. Persons with ARF often are asymptomatic, and the condition is diagnosed by observation of elevations in blood urea nitrogen (BUN) and creatinine [5]. The causes of ARF can be Pre-renal, post renal, and intrinsic renal [6]. Overall, 60% of cases of community-acquired ARF are due to Pre-renal condition. Some blood tests that are commonly used in patients with ARF or to

measure kidney function in people who may have kidney disease, these tests are creatinine, urea, uric acid, sodium, potassium, calcium, and phosphate, Chronic kidney disease (CKD) is identified by a blood test for creatinine, which is a breakdown product of muscle metabolism [3]. Higher levels of creatinine indicate a lower glomerular filtration rate and as a result a decreased capability of the kidneys to excrete waste products [4], urea is a small molecule that is produced in the liver from protein, it is normally put out by kidneys, so urea levels rise as disorder in kidneys functions. Recent professional guidelines classify the severity of CKD in five stages, with stage 1 being the mildest and usually causing few symptoms and stage 5 being a severe illness with poor life expectancy if untreated. Stage 5 CKD is often called end-stage kidney disease or end-stage renal failure [5]. Uric acid, a product of purine metabolism, is degraded in most mammals by the hepatic enzyme, urate oxidase (Uric case) to allantoin, which is freely excreted in the urine [6]. Renal handling of uric acid is a complex procedure and includes four sequential steps: (1) glomerular filtration; (2) reabsorption of about 98% to 100% in the proximal convoluted tubule; (3) secretion into the lumen of the distal portion of the proximal tubule; and (4) further reabsorption in the distal tubule. The net urinary excretion of uric acid is 6% to 12% of the amount filtered [7]. Sodium is the major cation of extracellular fluid it signifies approximately ~154 mmol of inorganic cation per liter of plasma (nearly about 90%). Sodium ion is accountable for almost one half the osmotic strength of plasma. It plays a central role in maintaining the normal distribution of water and the osmotic pressure in the extracellular fluid compartment. Potassium is the major intracellular cation. In tissue cells, its average concentration is 150 mmol/L, and in erythrocytes, the concentration is 105 mmol/L (~23 times its concentration in plasma). The body requirement for potassium is satisfied by a dietary intake of 50 to 150 mmol/day. Potassium is rapidly absorbed from the gastrointestinal tract and the kidneys excrete most of it [8].

Materials and Methods:

Forty patients complained from acute renal failure were included in this study. The range of their age was 35-60 years, twenty six of male and fourteen of female were included in this study. The patients were admitted to the AL-Hussain General Hospital in Kerbala for management, ARF were diagnosed by physicians. In addition, 30 sex and age matched healthy individuals were included as a control group. A questionnaire information from patients and control group, it contained the name, sex, age, duration and other disease, duration was in months. five milliliters of venous blood were obtained from each individual of the groups by antecubital venepuncture, using disposable sterile plastic syringes. The blood samples were collected in plain tubes (without anticoagulant), allowed to clot for 15 minutes in a water bath at 37°C. Serum samples were obtained by centrifugation of blood samples, then stored in frozen condition at (-20°C) waiting for analysis. Analysis was done within three days after storing. Before analysis, thawing at room temperature was carried out, and then serum samples used to determine urea, creatinine and sodium & potassium. Serum urea concentration was measured by enzymatic method Fawcett and Scott method [9], using a kit supplied by Biomerieux (France). Serum creatinine was measured by Jaffe reaction method [10] using a kit supplied by SYRBIO diagnostic reagents for laboratories under license of EUROBIO laboratories PARIS-France. Serum sodium and potassium were measured using FP20-photometer, reagents supplied by SEAC-Italy. The results were expressed as mean ± SD and analyzed statistically. The differences between the results of patients and control were assessed by student's t test; significant variation was considered when the P value was less than 0.05.

Results:

The results of serum urea, creatinine, uric acid, sodium and potassium measurements revealed significant elevation of the concentrations of urea (p= 0.032), creatinine (p=0.044), uric acid (p= 0.047), and potassium (0.040), while there was nonsignificnt decreased in sodium levels in patients of acute renal failure when compared with control group, these results illustrated in the following table and figures:

Table (1): serum creatinine, urea, and other parameters concentrations in patients of ARF and control subjects.

Parameter	Subject	Mean ± SD	P value
Creatinine (mg/dl)	Control Patients	0.68 ± 0.15 2.84 ± 1.66	0.032
Urea (mg/dl)	Control Patients	34.76 ± 8.20 42.88 ± 15.30	0.044
Uric acid (mg/dL)	Control Patients	4.84 ± 0.79 5.76 ± 2.43	0.047
Sodium (mmol/L)	Control Patients	120.18 ± 1.66 100 ± 11.45	N S
Potassium (mmol/L)	Control Patients	3.91 ± 0.34 5.33 ± 1.89	0.040

P value was less than 0.05

The variation of creatinine , urea, uric acid, and potassium levels were indicated to alter significantly by mean ± SD after 7-30 days. Its show in fig 1, 2, 3, 4.

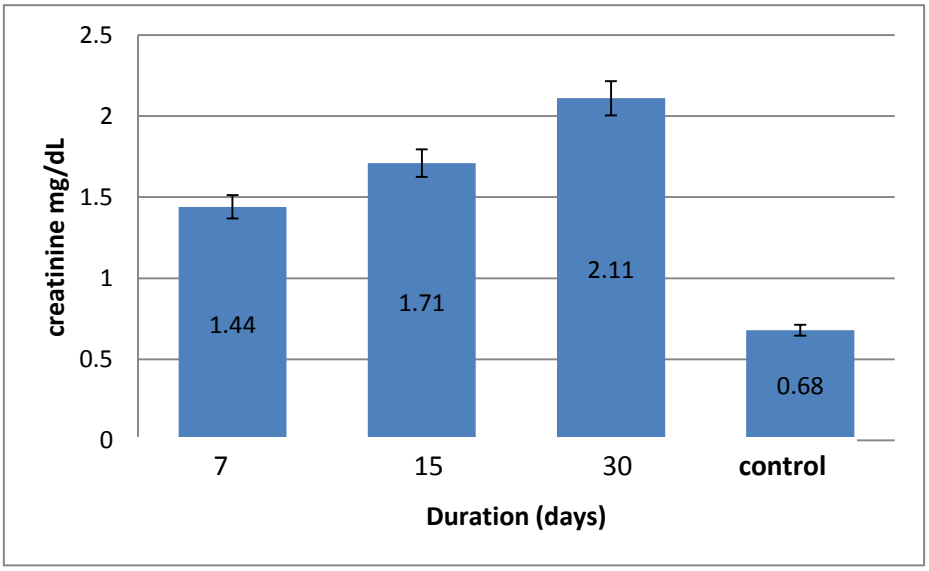

Fig (1): Results of effect of duration by days on creatinine concentrations in ARF patients .

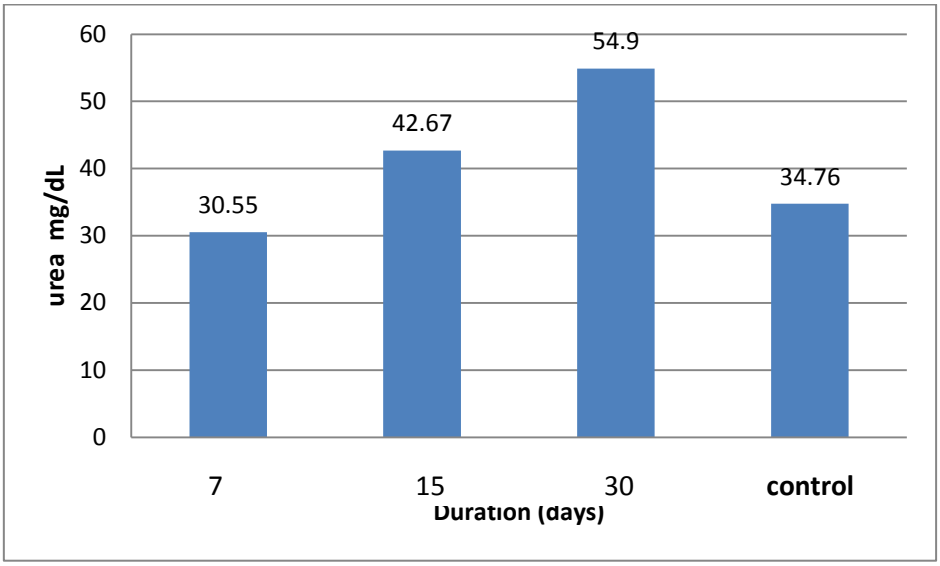

Fig (2): Results of effect of duration by days on urea concentrations in ARF patients.

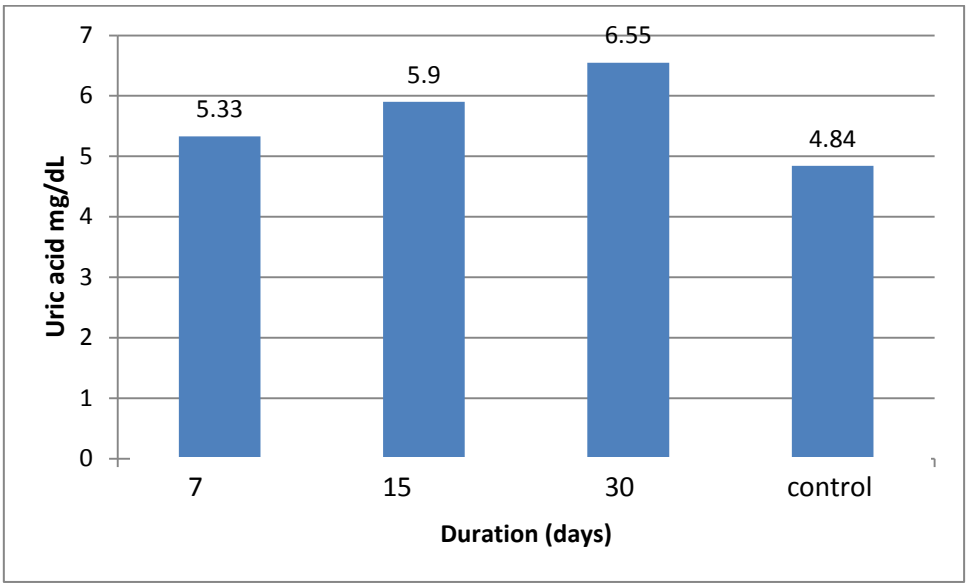

Fig (3): Results of effect of duration by days on uric acid concentrations in ARF patients.

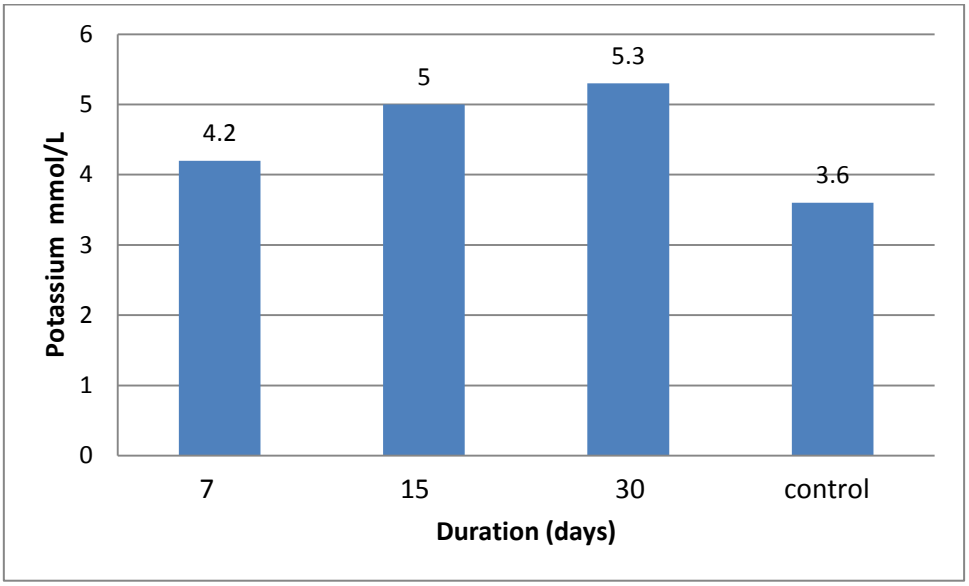

Fig (4): Results of effect of duration by days on potassium concentrations in ARF patients.

Discussion:

The results of biochemical parameters of patients with ARF and control group indicated elevation of concentrations of creatinine, urea, uric acid and potassium, while sodium concentration was insignificantly decreased, these results can be explained by: the effect of ARF on creatinine and urea concentrations was clearly the measurement of creatinine and urea in serum or plasma has been to assess kidney function [11]. Diagnosis of ARF is largely based on the clinical picture combined with the measurement of the serum creatinine level [12]. Other factors which affect creatinine and urea concentrations include age, sex, body habitus and diet [13], diet may have a rapid and transient effect on creatinine concentration and there is evidence that consumption of cooked meat, in particular, may affect ARF categorization based on estimated glomerular filtration rate [14]. An increase in serum creatinine of>50 μmol/L or an increase in serum creatinine of >50% from baseline, Further diagnostic information that can be obtained from the urinalysis includes evidence of proteinuria, hemoglobinuria, and casts or crystals in the urine. Blood tests creatinine provide information regarding the ability to remove nitrogenous wastes A major concern in the treatment of acute renal failure is identifying and correcting the cause (*e.g.*, improving renal perfusion, discontinuing nephrotoxic drugs), increase in creatinine level with increase of risk of ARF with decrease of glomerular filtration rate (GFR) [15]. High creatinine blood level may indicate serious damage or disease of the kidney is present, also can mean heart failure, dehydration, excessive blood loss that causes shock, gout and heavy protein meal intake [16]. Heavy exercise can also cause an increase in serum creatinine level, in addition medications (e.g. cimetidine or trimethoprim) can increase serum creatinine level by inhibition of creatinine excretion [17]. Increased serum urea is due to increased protein catabolism (result of heavy protein meal, severe stress, or upper gastrointestinal bleeding), or impaired kidney functions which may be pre renal, renal or post renal [18]. Estimation of serum urea and creatinine is usually regarded as the first line investigation of kidney functions. However as a test of renal functions serum urea is inferior to serum creatinine since 50% or more of urea filtered at the glomerulus is passively reabsorbed through the tubules. This fraction increases if urine flow rate decreases such as in dehydration, in addition urea is more affected by the diet than creatinine [19]. The levels of uric acid is also increased in the results of this study it is subjects with renal disease as the result of reduction in glomerular filtration rate GFR and renal urate excretion. Diuretics, such as thiazides, increase serum uric acid by stimulating both sodium and urate reabsorption in the proximal tubule [20]. Uric acid is commonly associated with hypertension. It is present in 25% of untreated hypertensive subjects, in 50% of subjects taking diuretics, and in >75% of subjects with malignant

hypertension. Hyperuricemia also predicts stroke in diabetic and non-diabetic subjects, hyperuricemia is known to cause AFR via intra renal crystal deposition [21, 22]. In addition it predicts the development of hypertension and renal disease in the general population [23]. Sodium and Potassium levels were varied of patients of ARF, these results may be described by Although small amount of potassium are lost each day in the stool and sweat, the kidney plays the major role in maintenance of potassium balance [24]. As renal function failures further, the ability to regulate sodium excretion is reduced. There is impaired ability to adjust to a sudden reduction in sodium intake and reduced tolerance of an acute sodium overload. Volume depletion with an accompanying decrease in the ARF can occur with a restricted sodium intake or excess sodium loss caused by diarrhea or vomiting. Salt wasting is a common problem in advanced renal failure because of impaired tubular reabsorption of sodium. sodium intake in persons with chronic renal failure often improves the GFR and whatever renal function remains. In patients with associated hypertension, the possibility of increasing blood pressure or production of congestive heart failure often excludes supplemental sodium intake. Approximately 90% of potassium excretion is through the kidneys. In renal failure, potassium excretion by each nephron increases as the kidneys adapt to a decrease in the GFR. As a result, hyperkalemia usually does not develop until renal function is severely compromised. Because of this adaptive mechanism, it usually is not necessary to restrict potassium intake in patients with chronic renal failure until the GFR has dropped below 5 mL/minute. Potassium homeostasis depends on maintenance of external and internal potassium balance. Exterior potassium balance is determined by the rate of potassium intake (100 meq/day) and rate of urinary (90 meq/day) and fecal excretion (10 meq/day). Internal potassium balance depends on distribution of potassium between muscle, bone, liver and red blood cells (RBC) and the extracellular fluid (ECF). This distribution is regulated by several hormones and is affected by acid-base balance and tonicity of plasma [25]. Hyperkalemia is defined as plasma potassium concentration > 5.0 mmol/L. Increased potassium intake is rarely a cause of hyperkalemia. Renal failure is the main cause of hyperkalemia, metabolic acidosis causes mild hyperkalemia, potassium sparing diuretics or ACE inhibitors may lead to hyperkalemia [26]. Each cell in the body must regulate its inside potassium content and concentration in order to control cell growth and division, metabolic reactions, acid-base balance, and cell volume. It is also important that appropriate potassium concentration gradients must be maintained across nerve and muscle cells so that appropriate electrical polarization of these cells is maintained for normal neuromuscular and cardiac activity. The movement of as little as 1.5-2% of the cell potassium into the extracellular fluid (ECF) can result in a potentially fatal increase in the plasma potassium concentration [27] Disorders of sodium balance resulting from primary renal sodium retention lead only to modest volume expansion without edema because increases in MAP quickly return sodium excretion to baseline levels. Examples of these disorders include chronic renal failure and states of mineralocorticoid excess. In this case, the price of a return to sodium balance is hypertension. Disorders of sodium balance that result from secondary renal sodium retention, as in congestive heart failure, lead to more profound volume expansion owing to hypotension [27]. Sodium loading is almost uniformly associated with an increase in Blood Pleasure in normotensive and hypertensive individuals because sodium retention cause extra cellular volume (ECV) expansion which leads to an increase in cardiac output and a rise in tissue perfusion to levels exceeding the metabolic needs [28]. Physiological normonatremia (a normal plasma osmolality) maintains an integrated system involving regulation of water intake via thirst and control water excretion via secretion of antidiuretic hormone [29]. Hyponatremia is almost always a condition of water excess while hypernatremia is due to water deficiency. Sodium chloride causes expansion of the plasma volume and a rise in the blood pleasure. The kidney plays a essential role in maintaining appropriate sodium balance which is critical for the determination of blood pleasure [30]. There are many other factors including genetic, nutritional, metabolic and neuro hormonal factors which may be able to impair the normal renal tubular sodium handling and hence may influence pressure homeostasis [31]. This study was demonstrated the duration was effect on the levels of all parameters, they were varied

with increased days (fig 1, 2, 3, 4), if increased of duration of ARF lead to increase the risk of patient.

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