Study the Effect of Seasonal Influenza Virus Infection on Patients with Acute Myocardial Infarction and Acute Kidney Injury

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Abstract

Influenza is a highly contagious acute respiratory disease of global importance that has caused epidemics and pandemics of human disease for centuries [1]. This study was designed to evaluate the effect of seasonal influenza virus infection on heart and kidney diseases. To investigate the effect of seasonal influenza virus infectionon acute myocardial infarction and acute kidney injury. The study enrolled a total of 178 subjects, involved 150 patients with influenza virus infection and with heart and kidney diseases, they were consisted of two group, the first investigated group was 101 patients with influenza and acute myocardial infarction (AMI), consisted of G1 of 41 patients suffering from acute myocardial infarction, G2 involved 32 patients infected with influenza and G3 were formed of 28 patients of acute myocardial infarction with influenza, they were compared with 14 normal healthy individual. The second group consisted of 49 patients with acute kidney injury AKI, G1 involved 10 patients suffering from acute kidney injury AKI, G2 were 19 patients suffering from mixed influenza virus infection according to physician reports, and G3 were 20 patients of influenza with acute kidney injury AKI they were compared with 14 normal healthy subjects. Patients with influenza and AMI were investigated for the activities of enzymes lactate dehydrogenase LDH and creatine kinase CK. Patients with influenza and AKI were evaluated for urea, uric acid, creatinine, total protein, albumin, globulin, and enzymes activities of amylase, gammaglutamyl transferase (GGT) and (CK) and LDH. They were compared with normal healthy individual. All the specimens of patients with influenza were obtained from different laboratories hospitals in Baghdad. Statistical analysis shows that there was very highly significant increase for enzymes activities LDH and CK activities ($P < 0.001$) for patients of G1 acute myocardial infarction, G2 influenza and, G3 influenza with AMI in comparison with normal healthy. The result for patients of G1 with acute kidney injury AKI show very highly significant increase in the enzymes activities of amylase, gammaglutamyl transferase, creatine kinase, and lactate dehydrogenase ($P < 0.001$) and in the concentration of urea, creatinine and uric acid ,and very highly significant decrease in total protein, albumin, and globulin ($P < 0.001$) as compared with normal healthy individual. Patient of G2 suffering from influenza disease show very highly significant increase in the enzyme s activities of CK, LDH, and albumin ($P < 0.001$).Highly significant change in protein, urea, creatinine and uric acid in comparing with normal healthy. Infection of influenza virus is one of the leading causes of morbidity and mortality in patients with heart and kidney diseases than in normal healthy persons. This may be because of inherently altered activity of the immune system. In our cohort of patients with influenza virus infection, patients who are suffering from influenza must be investigated for heart disease acute myocardial infarction ,acute kidney diseases, people with chronic medical disorders such as cardiovascular disease are particularly at risk.

Keywords**:** Influenza, Acute myocardial infarction, acute kidney injury, amylase, GGT, CRP.

Introduction

During influenza epidemics there are many deaths and serious complications in vulnerable populations. People with underlying chronic medical disorder such as cardiovascular disease are particularly at risk.[1,2]. Influenza is a highly contagious acute respiratory disease of global importance that has caused epidemics and pandemics of human disease for centuries. Influenzais caused by infection with virus which is a very small germ that infects many parts of the body, including lungs, and is the most frequent cause of acute respiratory illness requiring medical intervention because it affects the whole body and all age groups and it can occur in any individual [2,3]. The

illness affects the upper and/or lower respiratory tract and is often accompanied by systemic signs and symptoms such as the sudden onset of fever, severe headache, myalgia, and weakness, chills, loss of appetite, aching of head, arms and legs, muscle pains, and extreme fatigue [4,5]. The influenza sufferer may also have a sore throat and a dry cough, nausea, stuffy nose and burning eyes. Influenza is much more severe disease and is caused by a different type of virus [6]. Inflammation plays a decisive role in the pathophysiology of acute thrombotic events such as acute myocardial infarction .Vascular events may be related to short-term alterations of endothelial function and vascular relaxation, and these states could cause changes in the composition of atherosclerotic plaques [7,8,9].

Influenza and other respiratory infections may cause atherosclerosis through nonspecific immune stimulation or plaque rupture [10]. Fever can lead to endothelial dysfunction, hypercoagulability, or increased viscosity, Tachycardia, stress, or changes in metabolic risk factors in response to infection might also be implicated in acute myocardial infarction.

Infection may also trigger coronary artritis, spasm, or thrombosis. The currently favored mechanism is that infection triggers plaque rupture, partly mediated through an increased response to inflammatory stimuli in acute coronary syndrome [11,12]. It was suggested that a range of acute and chronic bacterial and viral infections might be associated with increased risk of acute myocardial infarction [13,14]. However; influenza remains an important focus because of the potentially important clinical and public health effects. Numerous studies have suggested that microbial agents may promote atherosclerosis, also it has been suggested that acute respiratory infection may be a risk factor for myocardial infarction, also it has been suggested that acute respiratory infection may be a risk factor for myocardial infarction [7,13,14,15]. Acute renal failure occurs suddenly and is usually initiated by underlying causes as dehydration, infection, serious injury to the kidney or chronic use of medication; it is often reversible with no losing damage. The early stage of chronic kidney diseases (CKD) define by the presence of proteinuria or glomerular filtration rate (GFR) of less than60 ml/min, or the presence of kidney damage regardless of the cause for three or more months. However, the exact impact has not been extensively investigated. It was reported that infected patients may develop serious respiratory symptoms and some of these with acute renal injury (ARI) [16,17,18]. Acute renal failure (ARF) has been reported as a frequent occurrence in critically ill patients with influenza virus of H1N1 [19].

There is very few reference on evaluation of biochemical parameter, LDH, CK, in case of seasonal influenza virus infection with acute myocardial infarction [17, 20] and no studies was performed on estimation of amylase GGT in heart and seasonal influenza virus infection. Some researchers evaluated CK, LDH, creatinine with acute kidney failure and seasonal influenza virus [17,20]. Some parameter in acute renal failure (ARF) has been reported as a frequent occurrence in critically ill patients with H1N1 (17). The present study aims to evaluate some biochemical parameters; serum enzymes activities of creatine kinase (CK), and lactate dehydrogenase (LDH) for patients suffering from acute, myocardial infarction. Amylase, gammaglutamyl transferase creatine kinase (CK), and lactate dehydrogenase (LDH), urea, creatinine and uric acid, total serum protein, albumin, globulin, were investigated in patient with acute kidney injury (AKI).

Patients and Methods

The study enrolled a total of 178 subjects consisted of 150 patients and 28 of control, the details of the investigated pathological cases are shown in tables, A, B, according to their ages and sex. Three groups of patients G1,G2,G3, illustrated in table A, the first group (G1), was confirmed of a 41 patients with acute myocardial infarction (AMI), they were obtained from Ibn-Al baytar hospital and Ibn Al-Nafess hospital for cardiac care of Baghdad from January 2011 to July 2014. The patients with myocardial infarction have received a number of diagnostic tests, such as electrocardiogram (ECG), a chest X-ray and blood tests for excluding heart muscle damage. A second group (G2) of table A included patients suffering from influenza they were 32

and the third group (G3) consisted of 28 patients with influenza and (AMI) acute myocardial infarction. All patients were compared with 14 normal healthy individuals. Table B consisted of three groups, first group (G1) consisted of 10 patients with acute kidney injury diseases, (G2) of 19 patients with influenza and (G3) of 20 patients with acute kidney and influenza diseases compared with 14 normal healthy individual. The specimens of the normal healthy individuals were obtained from routine clinical work; the specimens of all patients were obtained from different hospitals in Baghdad & during January 2011 to July 2014. All patients with influenza virus infection were investigated by physicans for different clinical and physical examinations and the Laboratory assessment of disease activity was made using blood tests. Blood collected, 5mL of venous blood were collected From each patient & control group ,separated by centrifugation at 3500rpm for 15 minutes and the obtained sera were put in plain tubes, refrigerated until time of analysis after 45-72 hrs, the stored sera used for different biochemical assay The following tables A and B explain design of specimens investigated in this studies:.

Table (A)
Gender and age of patients with acute myocardial infarction (AMI), influenza, and patientswithAMI& influenza.

Cases	*Number of cases*			*Relative Frequency %*	*Average age* (years)*	*Age Range (years)*
	Male	*Female*	*Total*			
Acute Myocardial infarction(AMI) G1	20	21	41	35.65	54.32±11.5	20-73
Influenza G2)	17	15	32	27.83	60.13±9.39	19-79
Influenza &AMI G3	13	15	28	24.35	58.25±6.6	29-76
Control	7	7	14	12.17	51.5±5.0	19-67
Total	57	58	115	100	56.5±7.63	19-76

**** Values are expressed as Mean ± SD.***

Table (B)
Gender and age of patients with acute kidney injury (AKI), influenza diseases and influenza with AKI diseases.

Cases	*Number of Cases*			*Relative Frequency %*	*Average age* (years)*	*Age Range (years)*
	Male	*Female*	*Total*			
Acute Kidney injury AKI G1	4	6	10	15.87	61.32±7.3	26-75
Influenza G2	9	10	19	30.15	54.9±9.51	18-69
Influenza & AKI G3	11	9	20	31.74	52.0±7.61	22-78
Control	7	7	14	22.23	53.0±8.9	19-76
Total	31	32	63	100	59.0±9.70	19-78

**** Values are expressed as Mean ± SD.***

Biochemical Assays

Lactate Dehydrogenase (LDH): The activity of LDH was determined by Randox kit method [21].

Creatine kinase: Total Creatine kinase activity was measured by spectrophotometer using kit method CK-NAC IFCC single vial reagent for quantitative determination of CK activity in human serum, Biolabo SA Reagents, Maizy, France [22].

Gamma Glutamyl Transferase: The activity of serum gamma glutamyl transferase (GGT, EC 2.3.2.2) was determined by kinetic method using a special kit (BIOLABO SA Reagents, Maizy, France)[23].

Amylase: The activity of amylase was determined by kit method, quantitative determination of amylase activity in human serum by amylase CNPG3 using kit (Biolabo SA, Reagents, 02160, Maizy, France)[24].

Blood urea was measured by Kit method, the concentration of blood urea was estimated by Berthelot enzymatic colorimetric method, by Urease/salycliate enzymatic method, using linear chemicals kit (Spain**)**.

Creatinine measured by deproteinisation procedure by Kit SYRBIO, diagnostic reagents for Laboratories underlicense of EUROBIO laboratories, Paris, France. Serum creatinine concentration was determined by Jaffe's method, creatinine in alkaline solution reacts with picric acid to form colored complex (creatinine picrate) which was measured at 520 nm.

Uric acid was measured by K it enzymati ccolorimetric method of uric acid, uricase-method, (Biolabo SA, Reagents, 02160, Maizy, France) Method.

Protein and Albumin: Total serum protein was measured by biuret reaction using kit method CE colorimetric method for total protein (linear chemicals S.L., Spain). Serum albumin was measured by kit CE colorimetric method of albumin (linear chemicals S.L.)**.**

Statistical Analysis: The Statistical methods were used in order to analyze and assess the results; they include SPSS program (version-10) to detect the value at α-level of significance. The significance of different means (quantitative data from different groups and from normal control group) was tested using analysis of variance (ANOVA) for more than two groups and using independent student t-test. The values are giving as mean ± standard deviation.

Result

The results were illustrated in Tables (1, 2 and 3). Table (1) illustrates the means values of serum LDH & CK activities in patients with acute myocardial infarction in comparison with normal healthy individuals for both sexes. The results show very highly significant difference in patients with acute myocardial infarction between male and female group for both LDH and CK activities ($P < 0.001$) when compared with normal healthy individual. Highly significant difference between male and female for control group for both LDH and CK activities ($P < 0.01$).

Table (2) represents the mean value of serum enzymes activities of LDH and CK in pathological cases, acute myocardial infarction G1, influenza G2, and influenza with acute myocardial infarction diseases G3.There were very highly significant differences for LDH and CK activities ($P < 0.001$) for patients of G1, G2 and G3 in comparison with normal healthy.

Table (3): demonstrates the mean value of some biochemical parameters for patients with acute Kidney injury G1, influenza G2, and influenza with acute kidney diseases G3. The results for patients of G1 with acute kidney injury AKI show very highly significant increase inenzymes activities of amylase, gammaglutamyl transferase, creatine kinase, and lactate dehydrogenase and in concentration of urea, creatinine and uric acid ($P < 0.001$) and very highly significant decrease in total protein, albumin, and globulin ($P < 0.001$) as compared with normal healthy individual.

Patients of G2 with influenza disease show very highly significant increase in enzymes activities CK, LDH, and albuminconcentration ($P< 0.001$). Highly significant increase was observed for concentration of total protein and uric acid ($P < 0.01$) and significant decrease in urea, and creatinine, ($P < 0.01$) and no significant differences for globulin and enzymes activities amylase, GGT, when compared with normal healthy individuals. Patients of G3 with kidney diseases and

influenza show very highly significant increase in the enzymes activity, amylase, GGT, Ck, LDH ($P < 0.01$) and rising in concentration of urea, creatinine and uric. Highly significant decrease for total protein, albumin and globulin concentration ($P < 0.01$) when compared with normal healthy individual.

Table (1)
Mean values of serum LDH& CK activities in patients with acute myocardial infarction in comparison with normal healthy individuals for both sexes.

Sex	*LDH (U/L)*		*CK (U/L)*	
	Normal	*Patients with AMI*	*Normal*	*Patient With AMI*
Male	N=7 169.1±23.65	N=21 485.9 ±43.72* (P < 0.001)	N=7 128.53±21.41	N=21 887.90 ±43.4* (P < 0.001)
Female	N=7 117.9±25.37**	N=20 405.0±47.20* (P < 0.001)	N=7 90.o±20.3**	N=20 825.98±41.5* (P < 0.001)
Total	N=14 143.5±26.78	N=41 445.45±48.81* (P < 0.001)	N=14 109.26±23.14	N=41 856.94±53.2 * (P < 0.001)

**** Very highly significant difference in patients with acute myocardial infarction for LDH and CKactivities (P < 0.001) when compared with normal healthy individuals.***

***** Highly significant difference between male and female for normal healthy individual for both LDH and CK activities (P < 0. 01).***

Table (2)
Values of serum enzyme activities of LDH and CK in patients with AMI, patients with influenza, and patients of AMI with influenza.

Cases	*Mean± SD*	
	LDH activity (U/L)	*CK activity (U/L)*
Normal individuals N=14	143.5 ± 26.78	109.26±23.14
(G1) patients with AMI N=41	445.45±48.0* (P < 0.001)	856.94±53.2* (P < 0.001)
(G2) patients with influenza N=32	382.65±37.92* (P < 0.001)	312.32±18.84*
(G3) patients with AMI and influenza N=28	542.64±56.16* (P < 0.001)	883.92±78.76* (P < 0.001)

**** Very highly significant difference at comparison of patients with normal.***

Table (3)
Mean values of some biochemical parameters in patients with acute kidney injury, patients with influenza infection, patients with acute kidney injury and influenza.

The values (Mean±SD)				
Biochemical parameters for both sexes	***Normal (n=14)***	***(AKI) G1(N=10)***	***Influenza G2(N=19)***	***AKI & influenza G3(N=20)***
Age (years)	48.16±4.2	61.0±4.4*	64.33±5.83*	62.45±6.17*
Urea (mg/dl)	34.08±6.43	100.54±31*	33.0±5.89**	176.20±34.65*
Creatinine (mg/dl)	0.875±0.113	68.4±12*	0.77±0.12**	9.92±1.72*
Uric acid (mg/dl)	4.55±0.74	9.09±2.12*	4.62±0.62**	7.78±1.06*
Total serumprotein (g/dl)	6.87±0.87	3.1±039*	7.52±0.66**	5.51±0.86*
Albumin (g/dl)	3.99±0.34	2.0±0.3*	4.55±0.33*	3.20±0.52*
Globulin(g/dl)	2.90±0.91	1.1±0.06*	2.90±0.67***	2.39±0.54**
Amylase(U / L)	36.0±6.80	165.83±3.81*	36±4.9***	162.54±18.1*
GGT(U/L)	35.41±6.9	115.73±3.36*	33.46±5.98***	110.70±15.37*
CK(U/ L)	109.26±23.10	412.40±32.8*	389.32±16.4 4*	739.23±.032*
LDH (U/L)	143.5 ± 26.78	354.30±2.8*	324.3 5 ± 37.92 *	586.0±3.5*

Mean±SD values of biochemical parameters., * Very highly significant difference at comparison of patients with normal healthy individuals. ** Highly significant difference. *** No significant.

Discussion

A few studies have examined individual-level biologic markers of acute respiratory infection and risk of AMI, but the results have not been consistent [7,9]. The present study included the influence of seasonal influenza virus infection in acute myocardial infarction and acute kidney injury. The result was illustrated in Table (1, 2, 3). It shows very highly significant increase in the enzymes activities of LDH & CK in acute myocardial infarction when compared with normal healthy individual table (1).This could be due to rate of releasing of enzyme depending on their intracellular location and molecular weight, the local blood and lymphatic flow [25,26]. Elevation of CK is an indication of damage mainly to plasma membrane of cardiac muscle in all pathological cases of heart failure, it is therefore indicative of injury to the heart muscle, myositis, myocardial infarction, myocarditis, malignant, muscular dystrophy, and after moderately severe exercise due to change in skeletal muscle [25,26]. Determination of cardiac enzymes is most frequently required for confirmation of suspected myocardial infarction, the result of increasing CK in acute myocardial infarction were in agreement with result of Galarraga B et al, and Maysoon, M.N. (26,27).

Table (2). demonstrateaa remarkable increases in the activities of LDH and CK in acute myocardial infarction G1, influenza G2, and influenza with acute myocardial infarction G3, as compared with normal healthy individual. When influenza strikes the lung, the lining of the respiratory tract is damaged, the tissues become swollen & inflamed, fortunately, the damage is rarely permanent, and this injury to the tissues may release enzymes LDH and CK into circulation and elevate their level in serum and the tissues usually heal within few weeks [8,9,10,13]. People suffering from chronic medical disorders as cardiovascular disease are particularly at risk [13,28]. The observed mean value of serum level LDH activity was 3.1, 2.7 and 3.8 folds higher than upper normal limit in patients with acute myocardial infarction G1, influenza G2, acute myocardial infarction with influenza, G3 respectively Table (2). And the observed mean value of serum level CK activity was 7.8, 2, 86, 8.1 folds higher than the upper normal limit, in patients with acute

myocardical infarction G1, influenza G2, acute myocardial infarction with influenza, G3 respectively Table (2). It was reported that seasonal patterns of cardiovascular deaths that were similar to patterns of influenza circulation .Clinical findings in patients with influenza revealed characteristic systemic effects such as high fever, myalgia, and fatigue, but also revealed frequent myocardial involvement [29]. These findings lead to the hypothesis that influenza might act as an acute inflammatory stimulus triggering cardiovascular events. Markers of systemic inflammation have been used to predict the risk of vascular disease in people and inflammatory cells are an important component of atherosclerotic plaques [30] The influenza virus has extensive effects on inflammatory and coagulation pathways [30], which might lead to destabilization of vulnerable atherosclerotic plaques and thus coronary artery occlusion the major cause of acute myocardial infarction [31].

Table (3) illustrated the mean values of the selected laboratory characteristics of patients with seasonal influenza virus infection and acute kidney injury. Patients with acute kidney injury G1, have remarkable increases in the concentratrion of urea, creatinine, uric acid and in the serum enzymes activity, amylase, GGT, CK, and LDH., and a remarkable reduction in the concentration of total serum protein, albumin and globulin as comparing with normal healthy group. The present results of urea, creatinine, uric acid, enzymes amylase and GGT \were in agreement with Maysoon M.N.(32) for patients with acute kidney injury.

Patients with influenza virus infection G2, show highly significant increase in concentration of urea, creatinine, uric acid, and concentration of serum total protein. There was a remarkably very highly significant increase in concentration of albumin and enzymes activities of creatine kinase and lactate dehydrogenase the result of these enzymes was in agreement with Martin-Loeches I et al [17]. The elevation of creatine kinase in acute kidney injury was in agreement with Sieew ED, et al [18]. There was no significant difference in globulin concentration and enzyme activities of amylase and GGT as compared with normal healthy. Patients with influenza infection and acute kidney injury (AKI) G3, represent remarkably very highly significant increases in the concentration of urea, creatinine and uric acid, enzymes activity and highly significant reduction in concentration of total protein, albumin and globulin when compared with normal healthy individual. One possible mechanism is glomerular deposition of viral antigens, which seems to be secondary to the deposition of immune complexes. That is, the abnormal expression of cytokine dysregulation associated with severe viral infection injury might contribute to the renal injury of influenza virus infection [17, 18, 19, 33]. Most infectious agents result in a chronic, indolent infection, which presumably increases chronic inflammation of the arterial walls; influenza induces notable acute arterial-wall inflammation and may trigger plaque destabilization that leads to acute coronary syndrome. It is essential to determine whether influenza directly affects the vascular walls and directly damages the arterial wall. Influenza might act as an acute inflammatory and procoagulant stimulus transiently altering endothelial function. [10]. Both coronary artery disease and influenza outbreak contribute significantly to worldwide morbidity and mortility. An increasing number of epidemiologic studies have concluded that atemporal association exists between acute viral illnesses and myocardial infarction. Viral illnesses such as influenza can cause orexacerbate coronary atherosclerosis by activating inflammatory pathways. [34].

Conclusion

Infection of influenza virus is one of the leading causes of morbidity and mortality in patients with heart and kidney diseases than in normal healthy persons. This may be because of inherently altered activity of the immune system. In our cohort of patients with influenza virus infection, patients who are suffering from influenza must be investigated for heart disease (acute myocardial infarction) ,acute kidney diseases, people with underlying chronic medical disorders such as cardiovascular disease are particularly at risk. In conclusion a suggestion that influenza may play a causal role in the development of

atherosclerosis and its complications and acute kidney injury. The common influenza when renal involvement does occur; it seems to result from dehydration, hypotension.

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الخلاصة

الانفلونزا مرض وبائى ناقل للعدوى بشدة عن طريق جهاز التنفسي و ذو اهمية عالمية ويسبب وباء شامل و عام منذ قرون عديدة. الهدف من البحث يوضح تأثير الاصابة بفيروس الانفلونزا المختلط وامراض مختلفة لحالات الجلطة القلبية الحادة و التهاب الكلية الحاد. تضمنت الدراسة 178 عينة وشملت 150 مريض مصاب بالانفلونزا و امراض القلب والكلية, وتكونت من مجموعتين, المجموعة الاولى تم اختبار (١٠١) مريضا مصابين بمرض الانفلونزا والجلطة القلبية الحادة, وتكونت من G1 وهم ٤١ مريضا يعانون من الجلطة القلبية الحادة، G2 تضمنت ٣٢ مريضا مصابين بالتهاب الانفلونزا, و G3 تكونت من ٢٨ مريضا مصابين بالجلطة القلبية الحادة و التهاب الانفلونزا. و تمت مقارنتهم مع ١٤ عينة من الاشخاص الاصحاء. المجموعة الثانية تكونت من ٤٩ مريض مصابين بأمراض الكلية الحاد, G1 شملت ١٠ عينات لمرضى يعانون من التهاب الكلية الحادة , G2 المجموعة الثانية تضمنت ١٩ مريض يعانون من الاصابة بفيروس الانفلونزا, و G3 هم 20 مريض مصاب بالانفلونزا والتهاب الكلية الحاد, تمت مقارنتهم مع ١٤ عينة من الاشخاص الاصحاء. وتم تقدير فعالية انزيمات اللاكتيت ديهايدروجينيز والكرياتين كاينيز في امصال المرضى المصابين بفيروس الانفلونزا والجلطة القلبية الحادة و المرضى المصابين بامراض الكلية الحادة والانفلزنزا. و تم تقدير تراكيز اليوريا, وحامض اليوريك و تراكيز البروتين, الالبومين, الكلوبيولين وفعالية الانزيمات الاملیز, كاما كلوتامايل ترانسفريز و اللاكتيت د يهايدروجينيز والكرياتين كاينيز, وتمت مقارنتهم مع ١٤ عينة للاشخاص الاصحاء و جمعت العينات من المستشفيات المختلفة في بغداد. اظهرت النتائج

انه هناك ارتفاع احصائي ملحوظ لفعالية كل من الانزيمات اللاكتيت ديها يدروجينيز والكرياتين كاينيز $P< 0.001$ لكل من المجاميع الثلاثة المصابين بالجلطة القلبية بمقارنتهم مع ١٤ عينة من الاشخاص الاصحاء الاصحاء. و بينت نتائج مرضى التهاب الكلية الحاد للمجموعه الاولى زيادة ملحوظة لفعالية الانزيمات الامليز,كاما كلوتامايل ترانسفريز, اللاكتيت ديها يدروجينيز والكرياتين كاينز $P< 0.001$, وتراكيز اليوريا, كرياتتين وحامض اليوريك. لقد لوحظ انخفاض احصائي ملحـوظ فى تراكيـز البروتيـن, الالبوميـن و الكلوبيولين $P<0.001$ بمقارنتهم مع ١٤ عينة من الاشخاص الاصحاء. مرضى المجموعه الثانية المصابين بالانفلونزا لوحظ ارتفاع ملحوظ لفعالية الانزيمات LDH,CK والالبومين وزيادة فى تراكيز البروتين, وتراكيز اليوريا كرياتتين, وحامض اليوريك. اما المجموعة الثالثة G3 هناك ارتفاع فى الانزيمات, اليوريا, كرياتتين وحامض اليوريك وانخفاض فى البروتين بمقارنتهم مع الاشخاص الاصحاء, ان الاصابة بمرض الانفلونزا الفيروسى هو احد الاسباب المؤدية لانخفاض وتغيير فعالية الجهاز المناعى والاصابة بمرض القلب وامراض الكلية وزيادة نسبة الوفيات، نستنتج انه مجموعة المرضى المصابين بالتهاب الانفلونزا الفيروسى يجب فحصهم لامراض القلب والكلية و الاشخاص الذين لديهم اعتلال جسدي مزمن كأمراض القلب او أمراض اخرى معرضين للخطر للاصابة بمرض الانفلونزا.