Research Article

Assessment of salivary immunoglobulin A interleukin-6 and C-reactive protein in chronic kidney disease patients on hemodialysis and on conservative treatment

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Abstract: Background: Chronic kidney disease is a gradual loss of kidney function with diabetes and hypertension as the leading cause. Chronic kidney disease is one of these systemic diseases that can affect salivary contents. Aims: This study aimed to assess salivary immunoglobulin A, interleukin-6 and C- reactive protein in chronic kidney disease patients on hemodialysis and those on conservative treatment in comparison with control subjects. Materials and methods: Ninety subjects were included in this study divided into three groups: 30 patients with chronic kidney disease on hemodialysis for at least 6 months ago; 30 patients with chronic kidney disease on conservative treatment and 30 healthy control subjects. Secretory immunoglobulin A, interleukin-6 and C- reactive protein in saliva samples were measured by enzyme-linked immunosorbent assay ELISA. Results: No significant difference in salivary immunoglobulin A level among study groups was seen. A significant increase in salivary interleukin-6 and C- reactive protein in both chronic kidney disease patients on hemodialysis and those on conservative treatment compared to the control group. While, no significant salivary IL-6 and CRP differences were seen between both patient groups, on hemodialysis and conservative treatment. Conclusions: There was no significant difference among chronic kidney disease patients on hemodialysis, on conservative treatment and control healthy subjects regarding to salivary IgA while Salivary interleukin -6 and C- reactive protein was significantly higher in chronic kidney disease patients on hemodialysis and those on conservative treatment compared to healthy subjects.

Keywords: Chronic kidney disease, hemodialysis, salivary IgA, salivary IL-6 and salivary CRP.

Introduction

Chronic kidney disease (CKD) is a progressive reduction in kidney function (1), with the prevalence and incidence growing worldwide with diabetes and hypertension as the leading cause [2].

Chronic kidney disease is classified into five stages according to the level of proteinuria and kidney function which is measured by the estimated glomerular filtration rate (eGFR) which is derived from age, gender, race and serum creatinine concentration [3]. Patients develop End-Stage Renal Disease (ESRD) once bilateral deterioration of nephrons pass the point of compensation therefore; dialysis therapy and renal transplantation are life-saving procedures in these patients [4]. Although renal transplantation is the preferred method of treatment for patients with ESRD, the majority of patients are placed on dialysis either while awaiting transplantation or as their only treatment [5].

In hemodialysis, urea and other low molecular weight substances diffuse during interchange from the patient's blood across an extra-corporal filtering/dialysis membrane into an electrolyte and

pH-balanced dialysis solution [6]. The frequency and duration of dialysis are related to residual kidney function, protein intake, body size and tolerance to fluid elimination. Typically, the patient undergoes hemodialysis three times per week, with each treatment session about three to four hours on standard dialysis units and slightly less time on high efficiency or high-flux dialysis units [7].

Studies showed that up to 90% of patients with kidney disease were found to have oral findings of uremia. Some of the presenting signs in renal patients were an ammonia-like taste and smell, gingivitis, stomatitis, reduced salivary flow, xerostomia, and parotitis [7]. The resultant anemia due to diminished erythropoietin leads to the paleness of the oral mucosa. Impairment of platelet function occurs during uremia [8]. This situation combined with the heparin use and other anticoagulants in hemodialysis leads patients to become prone to ecchymosis, petechiae, and hemorrhages in the oral cavity [9].

Saliva is a filtrate of the blood where different molecules pass through transcellular or paracellular routes (passive intracellular diffusion and active transport or extracellular ultrafiltration respectively) into saliva. As a result, saliva is equivalent to serum, therefore reflecting the physiological state of the body [10]. Numerous systemic diseases have been reported to cause marked and identifiable alterations in salivary secretion. CKD is one of these systemic diseases that can affect the contents of salivary secretion [11].

Immunoglobulin A (IgA), is a serum immunoglobulin and the dominant antibody class in the external secretions that bathe mucosal surfaces, which plays key roles in immunological protection. While serum IgA is predominantly monomeric in nature, the IgA in secretions (secretory IgA, S-IgA) is chiefly polymeric, comprising mainly dimeric forms [12]. It has been reported that Immunoglobulin levels, serum IgG isotypes, and both IgA and IgM production are normal in patients on dialysis [13].

The cytokines that are produced during inflammatory episodes, and that participate in them, are stimulators to produce acute-phase proteins. These inflammation-related cytokines include IL-1β, IL-6, tumor necrosis factor-α (TNF-α), interferon-γ, and transforming growth factor-β, with the most important ones are macrophages and monocytes at sites of inflammation. IL-6 is the main stimulator of the most acute phase of proteins production [14].

C-reactive protein is an acute-phase protein synthesized in the liver and secreted into the bloodstream during an inflammatory process, mostly in response to IL-6 signaling and, to a lesser extent, IL-1β and other pro-inflammatory cytokines [15].

The inflammatory response can reflect an underlying systemic disease. Chronic kidney disease patients demonstrate inflammatory pathways activation, which is accompanied by increased inflammatory markers like cytokines. The increased cytokines levels such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α) have been shown in ESRD. Moreover, these inflammatory markers act as toxins that predict deterioration of kidney function [16]. In oral cavity, these cytokines play an important role in the inflammatory response in the periodontium [17].

Materials and Methods

Ninety subjects were included in this study, divided into three groups: thirty patients with chronic kidney disease on hemodialysis for at least 6 months ago; thirty patients with chronic kidney disease on conservative treatment without hemodialysis and thirty healthy control participants with no signs and symptoms of any systemic disease, as a control group. Patients were taken from Al-kindey teaching hospital in Al-kindey dialysis center in Baghdad during the period from December 2017 to the end of February 2018. Patients under chemotherapy or/and radiotherapy, patients undergoing hemodialysis due to acute kidney failure or accident and hepatitis patients, were excluded from this study. For each participant in this study, a case sheet that included patients' demography, risk factors, family history, medical

history, history of present illness, investigations, oral manifestations and salivary parameters (salivary flow rate, PH) was filled. An oral examination was performed d for each participant using a dental mirror with artificial light with the oral manifestations recorded.

After the oral examination, saliva was collected from all individuals under the same conditions and each participant was instructed to rinse and wash his/her mouth with distilled water before saliva collection. Saliva was collected before a meal or at least one hour after a meal by spitting method for about 5-minutes. Sampling sessions are limited to the hours between 9:00 and 11:00 AM to minimize the effect of diurnal variations.

The samples were identified by a code number during the time of sample collection and processing. After the disappearance of the salivary froth, the salivary flow rate was calculated in milliliters per minute and pH was measured by a digital pH meter. After the collection of saliva samples, they were placed in a small cooler box and then, centrifuged at 3000 rpm for 10 minutes (Lasisi et al., 2015). The clear supernatant was taken and stored at -20°C until the time of analysis.

Secretory IgA, IL-6 and CRP in saliva sample were measured by Microplate reader Mindray MR-96A using ELISA kit for IgA, IL-6 and CRP, respectively.

Statistical analysis:

Statistical analysis was performed with SPSS (Statistical Package for Social Sciences; Version 21). Descriptive statistical analysis, contingency coefficient, Fisher exact, Chi-Square, analysis of Variance (ANOVA), Post-hoc (LSD and Dunnett T3) tests and Person Correlation Coefficient (r) were used in this study. $P < 0.05$ significant; $P < 0.01$ highly significant; $P > 0.05$ non-significant.

Results

Demographic finding

Demography

The age range at the first presentation was 25-75 years with an overall mean age of 49.6 years. Forty-six of them were males with a mean age of 47.8 and 44 of them were females with a mean age of 51.4. Thirty patients were with CKD on hemodialysis with an age range of 37-75 years and a mean age of 55.3. Seventeen of them were males and 13 were females, other thirty patients were with CKD on conservative treatment with an age range of 25-75 years and a mean of 49.3. Sixteen of them were males and 14 were females and thirty healthy subjects with an age range of 27-63 years and a mean of 44.2. Thirteen of them were males and 17 were females.

The participants were classified into two age categories: (≤ 50) and (more than 50 years of age).

A statistical analysis using contingency coefficient showed no significant difference in relation to age (P= 0.06) or gender (P= 0.056) among the study groups; table (1).

Table 1: Distribution of CKD patients and control groups according to age and gender.

			Groups			C.C	
			CKD (HD)	**CKD**	**Control**		**p-value**
Age	**≤ 50**	No. (%)	11 (36.6)	17 (56.6)	20 (66.6)	0.243	0.060
	More than 50	No. (%)	19 (63.3)	13 (43.3)	10 (33.3)		NS
Gender	**Male**	No. (%)	17 (56.6)	16 (53.3)	13 (43.3)	0.113	0.561
	Female	No. (%)	13 (43.3)	14 (46.6)	17 (56.6)		NS

C.C: contingency coefficient
CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Regarding occupation, thirty-one (34.4%) of the participants were retired followed by 24 (26.67%) who were unemployed then 22 (24.4%) were workers and 13 (14.4%) were officers. In CKD patients on hemodialysis, the majority were unemployed 13 (43.3%) followed by 9 (30%) were retired, 4 (13.3%) were workers and 4 (13.3%) were officers. Of those on conservative treatment most of them were retired 14 (46.6%) followed by 10 (33.3%) were workers, 3 (10%) were unemployed and 3 (10%) were officers. In the control group, 8 (26.6%) were retired, 8 (26.6%) were unemployed, 8 (26.6%) were workers and 6 (20%) were officers. A statistical analysis using the contingency coefficient showed that there was no significant difference among study groups regarding occupation (p= 0.06). Considering marital status, married participants were the most common (67) followed by single (16), widowed (5) and divorced (2). In CKD patients on hemodialysis, the majority were married 27 (90%) and 3 (10%) were single. In those on conservative treatment, 19 (63.3%) were married followed by 6 (20%) were single, 3 (10%) were widowed and 2(6.6%) were divorced. In the control group, 21 (70) were married followed by 7 (23.3%) who were single and 2 (6.6%) were widowed. Also, there was no significant difference among study groups considering marital status (p= 0.21).

Smoking status

The majority of the participants were non-smokers (71, 78.89%) followed by the current smoker (14, 15.56%) and ex-smoker (5, 5.56%). In CKD patients on hemodialysis, 26 (86.6%) were non-smokers, 3 (10%) were ex-smokers and 1 (3.3%) were current smokers. Of those on conservative treatment, 22 (73.3%) were non-smokers, 2 (6.6%) were ex-smokers and 6 (20%) were current smokers. While in the control group, 23 (76.6%) were non-smokers and 7 (23.3) were current smokers. By using Fisher's exact test, the result showed that there was no significant difference among study groups in relation to smoking status (p= 0.058). Current smokers were divided into three groups according to the number of cigarettes smoked per day: light (< 10), intermediate (10-20), and heavy smokers (> 20). Overall, intermediate smokers were the most common (11). In CKD patients on hemodialysis, 1 (7.1%) was an intermediate smoker. in those on conservative treatment, 5 (35.7%) were intermediate smokers and 1 (7.1%) was a heavy smoker. In the control group, 1 (7.1%) was a light smoker, 5 (35.7%) were intermediate smokers and 1 (7.1%) was a heavy smoker. Also, by using Fisher's exact test, the result showed that there was no significant difference among study groups regarding to number of cigarettes (p= 1.00).

Medical history

In relation to patients' medical history, 35 (58.33%) of CKD patients were with Diabetic Mellitus followed by 34 (56.67%) with hypertension. Of patients on hemodialysis, (14, 46.67%) were diabetic and

(19, 63.33%) were hypertensive. While in those on conservative treatment, (21, 70%) were diabetic and 15 (50%) were hypertensive.

By using the Chi-square test, the result showed that there was no significant difference between patient groups regarding diabetic and hypertension (p= 0.06, p= 0.29); table (2).

Table 2: Medical history of chronic kidney disease patients.

		Groups		Chi-square	P value
		CKD (HD)	CKD		
Diabetic	No. (%)	14 (46.6)	21 (70)	3.36	0.067 (NS)
Hypertension	No. (%)	19 (63.3)	15 (50)	1.08	0.29 (NS)

CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Family history:

Considering family history, 12 (20%) CKD patients were with a 1st relative degree history of CKD and 2 (3.3%) were with 2nd relative degree. In hemodialysis patients, 5 (16.6%) were with 1st relative degree and 1 (3.3%) was with 2nd relative degree family history of CKD. While in patients on conservative treatment, 7 (23.3%) were with 1st relative degree and 1 (3.3%) were with 2nd relative degree family history. Using the Chi-square test, the result revealed that there was no significant difference between patients groups in relation to family history (p= 0.51, p= 1.00); table (3).

Table 3: Family history of chronic kidney disease patients.

		Groups		Chi-square	P-value
		CKD (HD)	CKD		
1st degree	No. (%)	5 (16.6)	7 (23.3)	0.41	0.51 (NS)
2nd degree	No. (%)	1 (3.3)	1 (3.3)	0.00	1.00 (NS)

CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Salivary immunoglobulin A:

Using ANOVA test, there was no significant difference in salivary IgA level among CKD patients on hemodialysis, those on conservative treatment and control group (p= 0.3); table (4).

Table 4: Mean salivary IgA level in studied groups with ANOVA test.

	Groups	Mean ± SD	SE	Range	F	P value
IgA **µg/ml**	**CKD (HD)**	232.68 ± 124.42	22.72	33.63- 426.24	1.219	0.301
	CKD	234.76 ± 97.28	17.76	70.90- 415.50		NS
	Control	196.82 ± 93.05	16.99	50.67- 431.46		

F: ANOVA
CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Salivary interleukin- 6:

Using ANOVA test, there was a significant difference in salivary interleukin- 6 in CKD patients on hemodialysis, those on conservative treatment and control group as shown in table (5).

Table 5: Mean salivary interleukin- 6 of study groups with ANOVA test.

	Group	Mean ± SD	SE	Range	F	P value
IL-6 (ng/L)	CKD (HD)	161.41 ± 71.11	12.98	70.41-349.54	5.53	0.005 S
	CKD	146.17 ± 48.98	8.94	76.98- 265.76		
	Control	110.64 ± 59.94	10.94	68.67- 307.87		

F: ANOVA
CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Using post hoc (LSD) test, the result shows that there was a significant increase in salivary interleukin- 6 in CKD patients on hemodialysis and those on conservative treatment compared to the control group (p= 0.00, p= 0.03). While there was no significant difference in salivary IL-6 was seen between CKD patients on hemodialysis and those on conservative treatment (p= 0.33).

Salivary C- reactive protein

Table (6) shows that there was a significant difference in salivary CRP in CKD patients on hemodialysis, those on conservative treatment and control group.

Table 6: Mean salivary CRP of study groups with ANOVA test.

	Group	Mean ± SD	SE	Range	F	Sig.
CRP (mg/l)	CKD (HD)	2.18 ± 0.86	0.16	0.70- 4.58	4.49	0.014 S
	CKD	2.20 ± 0.86	0.16	0.87- 3.87		
	Control	1.50 ± 1.32	0.24	0.60- 5.97		

F: ANOVA
CKD (HD): chronic kidney disease on hemodialysis
CKD: chronic kidney disease on conservative treatment

Using post hoc (LSD) test, the result showed that there was a significant increase in salivary CRP in CKD patients on hemodialysis and those on conservative treatment compared to the control group (p= 0.01, p= 0.01). While there was no significant difference was found between salivary CRP in CKD patients on hemodialysis and those on conservative treatment (p= 0.93).

Correlation coefficient

A significant positive correlation was found between salivary IL-6 and CRP in CKD patients on hemodialysis (r= 0.781, p=0.00), those on conservative treatment (r= 0.840, p= 0.00) and in control group (r= 0.816, p= 0.00) as shown in table (7).

Table 7: Correlation between salivary IL-6 and CRP in CKD patients and control group.

Group			CRP
CKD on hemodialysis	IL-6	r	0.781
		P	0.000
CKD on conservative treatment	IL-6	r	0.840
		P	0.000
Control	IL-6	r	0.816
		P	0.000

Discussion

This study showed that the mean age of CKD patients on hemodialysis was 55.3 years while the mean age of CKD with conservative treatment was 49.3 years. This agrees with Denic et al., (2016)[18] who explained that kidney function decline with age. Considering gender, males were more than females in both patient groups. In CKD patients on hemodialysis, 17 were males and 13 were females while in CKD patients with conservative treatment, 16 were males and 14 were females. This result is in agreement with Goldberg and Krause (2016)[19] who found that a higher progression rate and mortality risk was seen in CKD males patients compared to females, while this result inconsistent with Ahmed et al. study (2015) [20] who reported that females patients were more than males patients.

Sex hormones are thought to play an important role in the biological mechanisms associated with variability in CKD prevalence and characteristics between males and females. Animal studies have demonstrated the harmful effect of testosterone and the protective effect of estrogen on several biological processes that are involved in renal damage. However, the role of sex hormones in clarifying gender-related differences in CKD in humans has not yet been established [19]. In this study, there were no significant differences among the studied groups regarding age and gender. This result is parallel with other study done by Khozeymeh et al. (2016) [16].

There was no significant difference among study groups considering to occupation and marital status. This result coincides with a study done by Huda et al., (2012)[21] for occupation, while it disagrees with the same study in relation to marital status. Another study was done by Pinho et al., (2015) [22] found that there was a significant association between CKD and marital status, which disagrees with the current study regarding marital status.

Living with a partner has been considered a family support indicator, which would be associated with better treatment commitment by CKD patients and better health outcomes [23]. This positive effect of living with a partner was not observed in the current study, which may be due to different population circumstances. Regarding smoking and the number of cigarettes per day, no significant difference among study groups which is inconsistent with a study done by Yacoub et al., (2010) [24] who found that current smokers were under an increased risk of having CKD compared to nonsmokers. Many studies explained that smoking is a risk factor for the progression of CKD [25, 26]

In this study, the majority of patients were either diabetic or hypertensive. In CKD patients on hemodialysis, the majority were with hypertension, while for those on conservative treatment, diabetic Mellitus was the most common, however, Chi square test was non-significant. This is in agreement

with other studies were done by Lea and Nicholas (2002) [27] and Suleymanlar et al. (2011) who reported that diabetes mellitus and hypertension were common among CKD patients. However, this disagrees with another study done by Kabir et al., (2012) [28] who found that there was a significant difference between cases and control regarding diabetic Mellitus and hypertension.

Diabetes mellitus and hypertension may be considered important causes of CKD; therefore, the international guidelines recommend yearly screening for CKD in diabetic or hypertensive patients [29]. Uncontrolled diabetes and/or hypertension can easily and quickly progress to end stage renal disease [30]. The majority of patients in both patients groups; on hemodialysis and on conservative treatment were with 1st degree relative family history of CKD.

No significant difference among studied groups in relation to 1st and 2nd family history. This is parallel with a study done by Kabir et al., (2012) [28] who found no significant difference regarding risk factor like family history. But, inconsistent with another study done by Orantes et al., (2011) [31] who found that developing CKD is significantly influenced by family history of CKD. A family history of kidney disease is one of the crucial risk factors for CKD. Therefore, it is advisable to screen high-risk family members of CKD patients to prevent the disease [30].

In the present study, no significant difference in salivary IgA level among study groups was found. This is inconsistent with other studies which reported a significantly higher level of salivary IgA in CKD patients compared to healthy subjects [32, 33]. Discrepancies among these results could be attributed to the differences in the sample size, patient factors and absence of infections.

Regarding salivary IL-6, a significant difference in salivary IL-6 levels among study groups was found. However, no significant salivary IL-6 difference between the two patient groups. A significantly higher level of salivary IL-6 in CKD patients on hemodialysis compared to the control group was seen. This finding is consistent with a study done by Khozeymeh et al. (2016) [16] who reported a significant increase in salivary IL-6 levels in hemodialysis patients compared to control subjects. Also, a significant increase in salivary IL-6 in CKD patients on conservative treatment compared to the control group was found. This is consistent with Ersson et al. (2011) [34] who reported a higher level of salivary IL-6 in CKD patients compared to control subjects, but unfortunately it was measured in a limited number of patients which was non statistically significant. Increased inflammatory biomarkers levels in CKD can promote atherosclerosis and thrombosis [35]. These mechanisms may explain the high prevalence of the cardiovascular disease among CKD patients. Therefore, the measurement of cytokine levels in saliva may be considered a noninvasive test for cardiac risk stratification in hemodialysis patients [16].

Many oral diseases including oral cancer, lichen planus and periodontal diseases have been reported to be associated with IL-6 deregulation [17]. Periodontal diseases are prevalent in patients on hemodialysis who showed bad oral care and their prevalence increases with the chronicity of the disease (Hamissi et al., 2009). The important role of IL-6 in the loss of periodontal ligament and alveolar bone through tissue degradation effects of IL-6 on connective tissue and bone, mediated by metalloproteinase and osteoclasts activity [17].

To our knowledge, few studies were performed to investigate the salivary IL-6 level in CKD patients, so further studies may be needed to confirm the pathological role of IL-6 in CKD patients. Regard-

ing salivary CRP, there was a significant difference among the study group. However, there was no significant difference in salivary CRP levels between the two patient groups. A significantly higher salivary CRP level in hemodialysis patients and those on conservative treatment compared to the control group was seen.

Pallos et al. (2015) [36] found that there was a significantly higher level of salivary CRP in patients on hemodialysis compared to normal subjects while no significant difference between those on conservative treatment and normal subjects. This finding agrees with the current study regarding hemodialysis patients but disagrees with the findings of conservative treated patients.

A few studies regarding CRP in the saliva of patients with CKD. However, several studies measured it in the serum of CKD patients and found a significant increase in CRP levels in the serum of patients with CKD [34, 37]. Importantly, periodontal disease can worsen CKD. A systemic review and meta-analysis reported an increased prevalence of CKD in patients with periodontitis [38]. Many studies have proved a positive association between the presence of chronic periodontitis and a high level of serum CRP [39, 40].

Inflammatory cytokines (IL-6, IL-1 and TNF-α) are released in a response to periodontal infection and stimulate hepatocytes to produce CRP. Therefore, in the presence of chronic periodontitis, higher serum CRP levels would be found [41]. A significant positive correlation between salivary IL-6 and CRP in CKD patients and the control group. IL-6 is known to induce the production of CRP in the liver [42]. Therefore, as expected, the levels of IL-6 and CRP were positively correlated in this study.

Conclusion

There was no significant difference between CKD patients and control healthy subjects regarding to salivary IgA. Salivary IL-6 and CRP were significantly higher in CKD patients on hemodialysis and those on conservative treatment compared to control healthy subjects. There was a significant positive correlation between salivary IL-6 and CRP in CKD patients and also in control healthy subjects. Patients with CKD need comprehensive professional oral care and self-care instructions.

Conflict of interest: None.

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العنوان: تقييم الغلوبولين المناعي اللعابي A و interleukin-6 والبروتين التفاعلي C في مرضى الكلى المزمنة عند غسيل الكلى والعلاج المحافظ
الباحثون: إيثار سالم امينة ريحان ديجيل
المستخلص:
الخلفية: مرض الكلى المزمن هو خسارة تدريجية في وظائف الكلى مع مرض السكري وارتفاع ضغط الدم كسبب رئيسي. مرض الكلى المزمن هو واحد من هذه الأمراض الجهازية التي يمكن أن تؤثر على محتويات اللعاب.
الاهداف: هدفت هذه الدراسة إلى تقييم الغلوبولين المناعي اللعابي ، انترلوكين ستة وبروتين سي التفاعلي في المرضى المصابين بمرض الكلى المزمن الخاضعين للغسل الكلوي والمرضى الذين هم على العلاج المحافظ والمقارنة مع الاصحاء.
المواد وطرائق العمل: تضمنت هذه الدراسة 90 مريضا مقسمة إلى ثلاث مجموعات: 30 مريضا يعانون من مرض الكلى المزمن على الغسل الكلوي منذ 6 أشهر على الأقل ؛ 30 مريضا يعانون من مرض الكلى المزمن والذين هم على العلاج المحافظ و 30 من الاصحاء. تم قياس الغلوبيولين المناعي الإفرازي، إنترلوكين ستة و بروتين سي التفاعلي في عينات اللعاب بواسطة **ELISA.**
النتائج: لا يوجد فرق كبير في الغلوبولين المناعي اللعابي بين مجموعات الدراسة. هناك زيادة كبيرة في انترلوكين ستة وبروتين سي التفاعلي في كل من مرضى الكلى المزمن الخاضعين للغسيل الكلوي والمرضى الذين هم على العلاج المحافظ مقارنة بمجموعة الاصحاء. في حين، لم يكن هناك أي فرق كبير في انترلوكين ستة وبروتين سي التفاعلي اللعابي بين المجموعتين من المرضى**.**
الاستنتاجات: لم يكن هناك فرق كبير بين المرضى المصابين بمرض الكلى المزمن والاصحاء فيما يتعلق بالغلوبيولين المناعي اللعابي بينما كان انترلوكين ستة وبروتين سي التفاعلي اللعابي أعلى بشكل كبير في مرضى الكلى المزمن الخاضعين للغسل الكلوي والمرضى الذين هم على العلاج المحافظ مقارنة بالاصحاء.