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RESEARCH ARTICLE

Studying the Level of Carboxy-Terminal Cross Link Telo Peptide Type-1 Collagen and Human Cartilage Glycoprotein in Sera of Iraqi Patients with Knee Osteoarthritis

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ABSTRACT

Knee osteoarthritis (KOA), commonly known as degenerative joint disease, is frequently brought on by wear-and-tear articular cartilage loss that occurs over time and most often affects the elderly. Since cartilage is the main element that breaks down when OA occurs, its chemical components can be exploited to develop a sensitive biomarker to identify the beginning and progression of OA disease. The study aimed to evaluate and assess the alteration in the serum level of collagen type I C-telopeptide (CTX-1), and human cartilage glycoprotein (YKL-40) in serum samples obtained from (81) patients diagnosed with Knee Osteoarthritis who were hospitalized in Baghdad Hospital in Baghdad Medical City, from April 2023 to July 2023. The laboratory test results were compared concerning this group and a group of healthy individuals (40). A statistically significant difference was found in the level of CTX-1, YKL-40, HDL, LDL, VLDL, TG, and cholesterol in patients with Knee Osteoarthritis compared to the control group. At the same time, there was no statistically significant difference between the two groups in BMI, Calcium ion, and ESR. According to the binary logistic regression analysis a statistically significant correlation was shown between the prevalence of KOA and CTX-1, YKL-40. Under the results of the ROC curve, CTX-1 exhibited an area under the curve (AUC) of 1.00, in YKL-40 was 0.994 in people with KOA. In conclusion, the serum levels of CTX-1, and YKL-40 can be regarded as trustworthy markers that can reliably be used to diagnose KOA patients.

Keywords: Age, CTX-1, Knee osteoarthritis, Lipid profile, YKL-40

Introduction

Osteoarthritis (OA) a primary cause of severe, ongoing pain and impairment, affects 10% of the world's population.[1] It is a chronic inflammatory disease that affects human joints and is primarily found in the knees and hips.[2] Although OA is a chronic condition accompanied by inflammatory symptoms, it is not an autoimmune condition like rheumatoid arthritis.[3] Rates for women are reportedly significantly higher than those for men.[4] OA disease's start and progression are correlated with inflammation.[5] The World Health Organization (WHO) has named the 2020–2030 decade the "Decade of Healthy Ageing," highlighting the need to address chronic diseases with no known cure, such as OA, that significantly affect the quality of life connected to health.[6] Functional limitations, structural changes, and impairment are connected to bone alterations, cartilage degradation generation, and injury to the nearby soft tissue beyond the limitations of structure and function.[7–9] Collagen is the most prevalent protein in the human body and the primary structural protein in the extracellular matrix of the different connective tissues. It is present in the tendons, skin, muscles, and bones the material that unites the body. Collagen creates a

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scaffold to offer support and framework. There are at least 16 different varieties; however, between 80 and 90 percent of the body's collagen is synthetic, including categories I, II, and III. These collagen molecules assemble to create long, thin fibrils with a similar structure.[10] Osteoclasts during collagen degradation cut type I collagen into small pieces called collagen type I C-telopeptide CTX-1.[11] A marker of osteoporosis and bone resorption, CTX-1 is also known as the C-terminal end of the telopeptide of type I collagen or carboxy-terminal cross-linked telopeptide of type 1 collagen. A popular bone turnover marker (BTM) that is simple to assess in plasma, serum, or urine is CTX-1. Bone turnover is the process by which new bones are generated after the resorption of existing ones.[12] Cathepsin K cleaves intact collagen type 1 to produce CTX-1, which is then recognized by an antibody that recognizes the eight amino acid sequence EKAHDGGR.[13,14]

YKL-40 also known as Chitinase-3-like protein 1 (CHI3L1), a member of the 18 glycosyl hydrolase family, is present in large quantities in chondrocytes and synoviocytes.[15] The arthritic joint produces YKL-40, which consists of 40-kDa heparin-human cartilage glycoprotein-39, from various cell types. Its name is derived from the three terminal amino acids' one-letter codes, tyrosine (Y), lysine (K), and leucine (L).[16] Regarding the biomarkers that identify the development and severity of OA disease, researchers have devoted numerous resources to hunting for a particular, sensitive, and specific biomarker to diagnose OA.[17,18] The present study aims to find a new and important parameter that could be connected and play the original roles of Knee Osteoarthritis diseases as diagnostic indicators.

Materials and methods

The study was conducted on 121 persons, including 81 cases (62 female, 19 male) they were diagnosed with KOA by x-ray with the help of specialist doctors, and 40 healthy persons (34 female, 6 male) as control. The age of the subjects was more than 45 years. The study started from (April to July 2023), in the Orthopedic Consultancy Department of Baghdad Hospital at Baghdad Medical City. Venous blood samples were taken (5ml) and after centrifugation, serum was extracted, and kept at -20C for further analysis. Inclusion criteria: Using magnetic resonance imaging and X-rays, osteoarthritis was clinically diagnosed in every patient included in the present study. Exclusion Criteria: RA patients, PCOS (polycystic ovary syndrome), Diabetes, Gout, cancer, Thyroid patients, pregnant, and lactating women were excluded. The body mass index (BMI) was determined using weight and height, and CTX-1 levels in serum were calculated using the enzyme-linked immune sorbent assay (ELISA) competitive enzyme type. This method involves connecting an antibody or antigen to an assay enzyme, while the serum level of YKL-40 was measured using the (ELISA) method sandwich type, by My BioSource Kit (USA). Cholesterol, Tri Glyceride (TG), and High-Density Lipoprotein (HDL), Calcium (Ca), concentrations were calculated using a spectrophotometer method in the Human Reader HS device. ESR was calculated by the Westergren method.[19] The Womac scale has been taken into account, including (Gender, family history, pain level, swelling, stiffness, and lameness), and finally Kellgren-Lawrance.

Statistical Analysis System-SPSS software version 26.0 analyzed how various groups (patients and controls) affected study parameters. The student *t*-test was used to compare two means in a significant way. as well as the mean±Standard Error (SE) of continuous variables, was used to perform descriptive statistics. Probability values determine the statistical significance; ($p \leq 0.01$) it was considered very significant, at ($p < 0.05$) it was considered significant and at ($p > 0.05$) it was considered non-significant. ROC curve was also applied and the area under the curve was estimated.

Results and discussion

A high significant difference was indicated between Knee Osteoarthritis patients and the controls concerning age, Cholesterol, Triglyceride (TG), High-Density Lipoprotein (HDL), Low-Density Lipoprotein (LDL), Very Low-Density Lipoprotein (VLDL), YKL-40, CTX-1. Moreover, results of BMI, calcium ion, and ESR were not significant between the two groups (diseased and control) $p > 0.05$. As shown in Table 1.

Fig. 1 shows the Mean ± SE of serum level of CTX-1, and YKL-40 in KOA diseased persons and controls.

When the associated symptoms of Knee Osteoarthritis are detected, WOMAC is taken into account and diagnosed by evaluation (low, medium, high). Patients were asked about the following symptoms, level of pain, swelling, stiffness, family history, and lameness, the results were linked in the following two tables. Kallgren-Lawrence scale: The knee radiograph is still the most used modality for diagnosing osteoarthritis, even with the advent of sophisticated medical imaging methods like Computed Tomography (CT) and Magnetic Resonance Imaging (MRI). The Kellgren-Lawrence (KL) scale is used to grade the severity of the condition. Grade 0 denotes the absence of radiographic signs of osteoarthritis (OA). Grade 1 indicates probable joint space narrowing

Table 1. Descriptive statistical analysis according to Age, BMI, Calcium, Triglyceride, LDL, HDL, VLDL, ESR, YKL-40, and CTX1) in the studied population.

Parameters	Controls Mean ± SE	patients Mean ± SE	P-value
Age/years	47.50 ± 0.92	56.24 ± 0.97	0.0001*
BMI (kg/m^2)	29.75 ± 0.75	30.30 ± 0.56	0.561
Calcium (mg/dL)	9.80 ± 0.06	9.65 ± 0.05	0.092
Cholesterol (mg/dL)	175.79 ± 3.82	213.44 ± 4.55	0.0001*
Triglyceride (mg/dL)	114.46 ± 4.88	169.27 ± 4.72	0.0001*
HDL-C (mg/dL)	44.03 ± 0.43	41.34 ± 0.33	0.0001*
LDL-C (mg/dL)	106.25 ± 3.13	137.87 ± 3.98	0.0001*
VLDL-C (mg/dL)	22.89 ± 0.97	33.86 ± 0.94	0.0001*
ESR (mm/h)	15.10 ± 1.26	14.60 ± 1.03	0.762
YKL-40 (pg/mL)	296.75 ± 2.75	518.87 ± 21.48	0.0001*
CTX-1 (pg/mL)	1115.30 ± 16.96	2111.22 ± 62.38	0.0001*

Data were presented as Mean ± SE (Median).
*Significant difference between two independent means using Students-t-test at 0.05 level.
BMI: Body mass index, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, VLDL: Very Low-density lipoprotein, ESR: Erythrocyte Sedimentation Rate, CTX-1: cross-linked C-telopeptide of type I collagen, YKL-40 Human cartilage glycoprotein 39, *p*-value: probability, **: *p*-value ≤ (0.01) high significant.

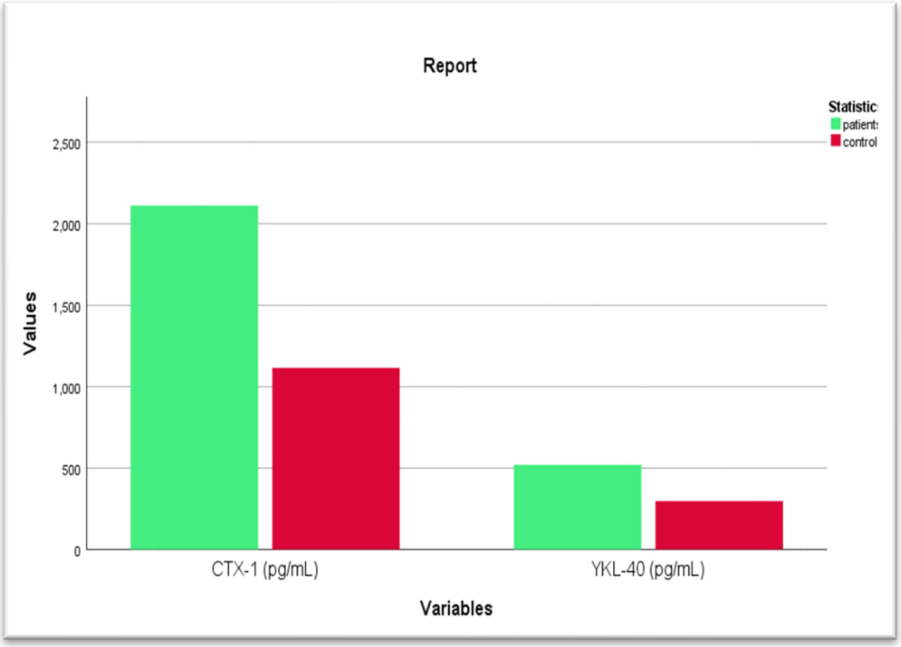

Fig. 1. Serum level of CTX-1 and YKL-40 between Knee OA patients and control.

(JSN). Grade 2 suggests definite osteophytes and possible JSN, in The anteroposterior weight-bearing radiograph. Grade 3 suggests multiple osteophytes, definite JSN, sclerosis, and possible bony deformity. Grade 4 suggests large osteophytes, marked JSN, severe sclerosis, and definite bony deformity.

Eta is a measure of association that is used when we have a nominal variable and variable measured at scale level. According to the results presented in the current study, the data showed that there is an association between swelling and CTX-1, and also between Stiffness and CTX-1, where the closer the value is to 1, the more impactable it becomes. As for the rest of the parameters, they turned out not to be affected by the level of CTX-1, as shown in Table 2.

As for the YKL-40, the results showed the presence of an association between YKL-40 and the Kellgren-Lawrence scale for Knee OA. Kellgren-Lawrance scale showed the highest value in Eta measurement 0.5 compared to the rest of the variables. As shown in Table 3.

The correlation showed no effect between the CTX-1 and the rest of the variables, while the YKL-40 had a positive effect on {highly significant ($p \leq 0.01$) with (Age, Cholesterol, and LDL), a significant ($p < 0.05$) with (TG, and VLDL)}. Reversely effect in {high significant with (Ca, and HDL), significant with (ESR)}. Also, there is a relationship between variables: some of them, high significance in the lipid profile, and Age with BMI, Ca, and ESR. As shown in Table 4.

Table 2. The association analysis according to (gender, family history, pain level, swelling, stiffness, lameness, and KELLGREN_LAWRENCE) as independent variables with CTX-1 as a dependent variable in the Knee OA patients' group.

Parameters	Pearson Chi-Square	Eta	Asymptotic Significance (2-sided)
Gender * CTX_1	81	0.08	0.32
Family history * CTX_1	159.3	0.1	0.32
Pain level * CTX_1	158	0.07	0.35
Swelling * CTX_1	228	0.3	0.47
Stiffness * CTX_1	231.9	0.35	0.4
lameness * CTX_1	78.9	0.23	0.38
Kellgren- Lawrance * CTX_1	243	0.26	0.23

WOMAC: a non-radiographic classification system of osteoarthritis, taking into account pain, stiffness, and functional limitation, Kellgren-Lawrnce: Radiographic systems to classify osteoarthritis. [20]

Table 3. The association analysis according to (gender, family history, pain level, swelling, stiffness, lameness, and KELLGREN_LAWRENCE scale) as independent variables with YKL-40 as a dependent variable in the Knee OA patients group.

Parameters	Pearson Chi-Square	Eta	Asymptotic Significance (2-sided)
Gender * YKL-40	120	0.13	0.30
Family history * YKL-40	160	0.22	0.35
Pain level * YKL-40	160	0.16	0.35
Swelling * YKL-40	232.8	0.29	0.45
Stiffness * YKL-40	234.4	0.229	0.42
lameness * YKL-40	80	0.15	0.38
KELLGREN LAWRENCE * YKL-40	240	0.5	0.38

KELLGREN_LAWRENCE classification (KL): AP knee radiographs were used in the original description of the KL classification. Every radiograph was given a rating between 0 and 4, which corresponded to increasing OA severity. A score of 0 indicated no OA at all, while a grade of 4 indicated severe OA. [21]

Table 4. The estimated correlation between CTX-1, YKL-40, and other examined biomarkers in KOA patients.

		Age	BMI	Calcium	Triglyceride	cholesterol	LDL	HDL	VLDL	ESR	YKL-40	CTX_1
Age	P	1	–.264*	–.236*	.153	.167	.162	–.035	.153	–.304**	.291**	.004
	R		.017	.034	.173	.137	.148	.755	.174	.006	.009	.971
BMI	P		1	.074	.008	.118	.109	.043	.007	.232*	–.078	.065
	R			.509	.942	.295	.335	.705	.948	.037	.489	.564
Calcium	P			1	–.038	–.119	–.143	.050	–.036	–.064	–.296**	–.202
	R				.739	.290	.202	.656	.750	.573	.008	.070
Triglyceride	P				1	.803**	.717**	–.422**	1.00**	–.052	.239*	.048
	R					.000	.000	.000	.000	.642	.033	.673
Cholesterol	P					1	.986**	–.456**	.801**	–.122	.417**	.143
	R						.000	.000	.000	.279	.000	.204
LDL	P						1	–.515**	.715**	–.139	.455**	.146
	R							.000	.000	.216	.000	.192
HDL	P							1	–.421**	.032	–.302**	.032
	R								.000	.774	.006	.778
VLDL	P								1	–.051	.238*	.047
	R									.651	.033	.678
ESR	P									1	–.231*	.032
	R										.040	.776
YKL-40	P											.191
	R											.09

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

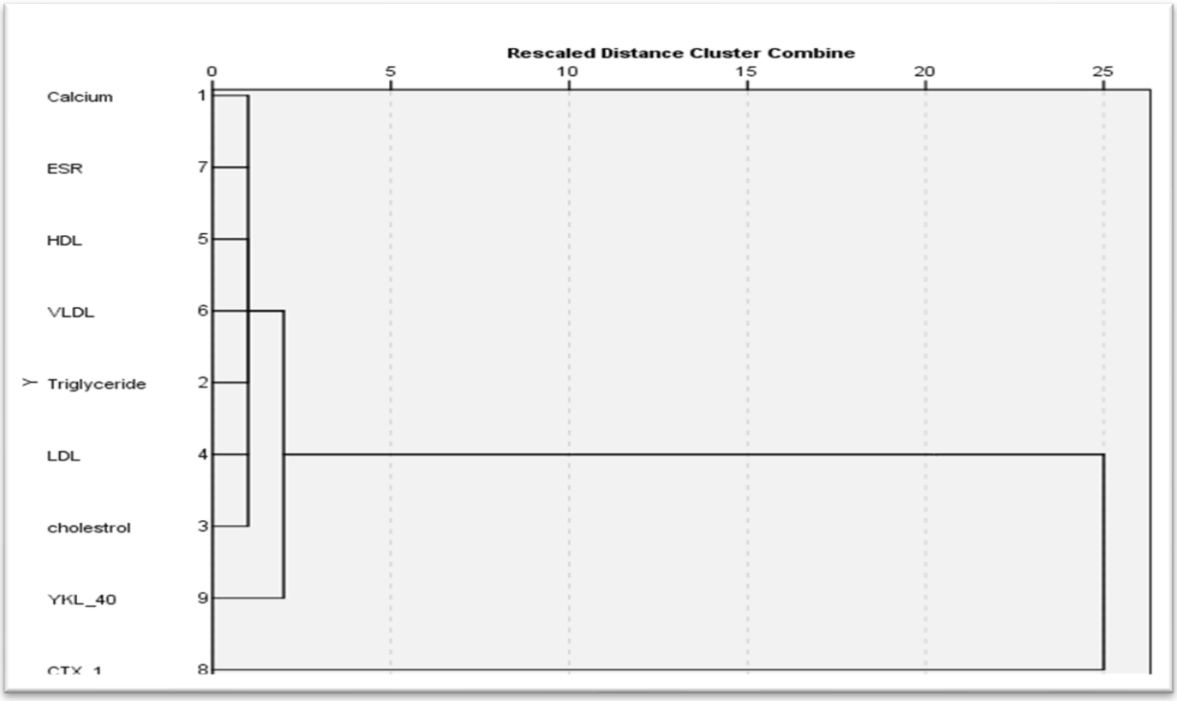

Chart 1. Cluster analysis of variables (Calcium, Triglyceride, cholesterol, LDL, HDL, VLDL, ESR, YKL-40, and CTX-1) in KOA patients' group.

The cluster analysis aims to organize variables. By looking for variables that are connected to or reliant on others, grouping them into a cluster or section, and separating them from other variables that are distinct from one another, the tool seeks to accomplish group variables. Wards method is one of the oldest cluster analysis techniques. A dendrogram is frequently used to show this strategy. Because there is no previous assumption of grouping in this test, the cluster analysis is employed to identify commonalities between researched variables. The variables in all studded groups, according to coefficients, are distributed in 2 clusters, with minor shifting in certain groups.

In the cluster analysis of patients, it was observed that the parameters (Calcium, ESR, HDL, VLDL, TG, LDL, and Cholesterol) formed one group, while (VLDL, and YKL-40) comprised another group. The results suggest a high degree of similarity among all the parameters within the one group, as their distances from each other are nearly identical. For that, VLDL showed a similarity to YKL-40. As for the CTX-1 showed an unimportant effect within the group, as shown in Chart 1.

In Table 5, There hasn't been any discernible association between the CTX-1 parameter with the rest variables, while the YKL-40 parameter had a significance on HDL, TG, Cholesterol, and VLDL (p-value < 0.05), and a high significance on LDL (P-value ≤ 0.01). There is an effect between the markers, showing a significant between (age with Calcium) P-value < 0.05. The table showed a high significance between (BMI with TG, VLDL, ESR) (TG with Cholesterol, LDL, HDL, and VLDL) (Cholesterol with LDL and VLDL) (LDL with VLDL) (HDL with VLDL) P-value ≤ 0.01.

In the cluster analysis of control, it was observed that the parameters (Calcium, ESR, HDL, VLDL) formed one group, (TG, LDL, Cholesterol, and YKL-40) formed another group, while (VLDL with Cholesterol) comprised another group. The results suggest a high degree of similarity among the parameters within the one group, as their distances from each other are nearly identical. As for the CTX-1 showed an unimportant effect within the group, as shown in Chart 2.

The optimal cut-off values for the serum biomarkers in distinguishing between Knee OA and healthy conditions, as determined by ROC curve analysis, are as follows:CTX1: Sensitivity: 100.0%, Specificity: 99.9%, Cutoff Value: 1306.1, as shown in Table 6.

The ROC analysis showed that CTX-1 in the KOA had a very good sensitivity (the area under the curve is 1.000%). Specificity 99.9%, Cutoff Value: 1306.1 as shown in Fig. 2.

The optimal cut-off values for the serum biomarkers in distinguishing between Knee OA and healthy conditions, as determined by ROC curve analysis, are as

Table 5. The correlation analysis for (age, BMI, Calcium, Triglyceride, cholesterol, LDL, HDL, VLDL, ESR, YKL-40, and CTX-1) in the control group.

		age	BMI	Calcium	Triglyceride	Cholesterol	LDL	HDL	VLDL	ESR	YKL-40	CTX_1
Age	P	1	–.129	–.373*	.244	.217	.124	–.124	.241	.109	.084	.127
	R		.426	.018	.129	.178	.447	.446	.133	.502	.608	.434
BMI	P		1	.297	.420**	.200	.142	–.216	.420**	.486**	–.007	–.031
	R			.062	.007	.216	.381	.180	.007	.001	.967	.847
Calcium	P			1	–.057	–.110	–.035	–.038	–.058	.139	–0.01	–.051
	R				.728	.498	.830	.818	.724	.391	0.9	.754
Triglyceride	P				1	.566**	.499**	–.449**	1.00**	.169	.377	.112
	R					.000	.001	.004	.000	.297	.016	.493
Cholesterol	P					1	.945**	–.165	.569**	.092	.385	.223
	R						.000	.309	.000	.572	.014	.167
LDL	P						1	–.193	.502**	.102	.438**	.118
	R							.232	.001	.533	.005	.468
HDL	P							1	–.446**	–.242	–.305*	.029
	R								.004	.133	.050	.857
VLDL	P								1	.168	.380*	.112
	R									.301	.016	.493
ESR	P									1	–.207	–.048
	R										.199	.769
YKL-40	P										1	.121
	R											.40

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 6. ROC result analysis of CTX-1 using Knee Osteoarthritis patients.

					Asymptotic 95% Confidence Interval	
Parameters	Area	Sensitivity	Specificity	Cutoff	Lower Bound	Upper Bound
CTX-1	1	100	99.9	1306.1	0.9	1

Table 7. ROC result analysis of YKL40 using Knee Osteoarthritis patients.

					Asymptotic 95% Confidence Interval	
Parameters	Area	Sensitivity	Specificity	Cutoff	Lower Bound	Upper Bound
YKL-40	0.99	94	100	378.2	0.98	1

follows YKL-40 Sensitivity: 94%, Specificity: 100%, Cutoff Value: 378.2, as shown in Table 7.

The Receiver Operating Characteristic Curve shared excellent sensitivity obtained from YKL-40 as a biomarker for the prognosis of KOA diseases with an area under the curve (AUC) of 0.99, as shown in Fig. 3.

CTX-1 levels showed high significance in the present study, $p \leq 0.01$ when CTX-1 levels in KOA patients were compared to those in the control group, the impact was significant. In the study by Sudhir S *et al.*,[22] the CTX-1 was discovered to be the most significant for predicting the overall KOA in patients, and in the study by Jayabalan P, *et al.*,[23] these reports supported our conclusions about the role of CTX-1. As for the YKL-40 parameter, normal people have modest levels of YKL-40. However, it is abundant in articular chondrocytes and is mostly located in the surface and middle layers of cartilage.[24] The levels of YKL-40 in serum were highly significant ($p \leq 0.01$) in the present study which increased in Cartilaginous tissue as for Knee OA patients. The study by Karalilova, *et al.* and Wang *et al.*[15,25] also found to associate YKL-40 with Knee OA diseases, where they proved the glycoprotein YKL-40 was of great impact. These reports supported our conclusions about the role of YKL-40.

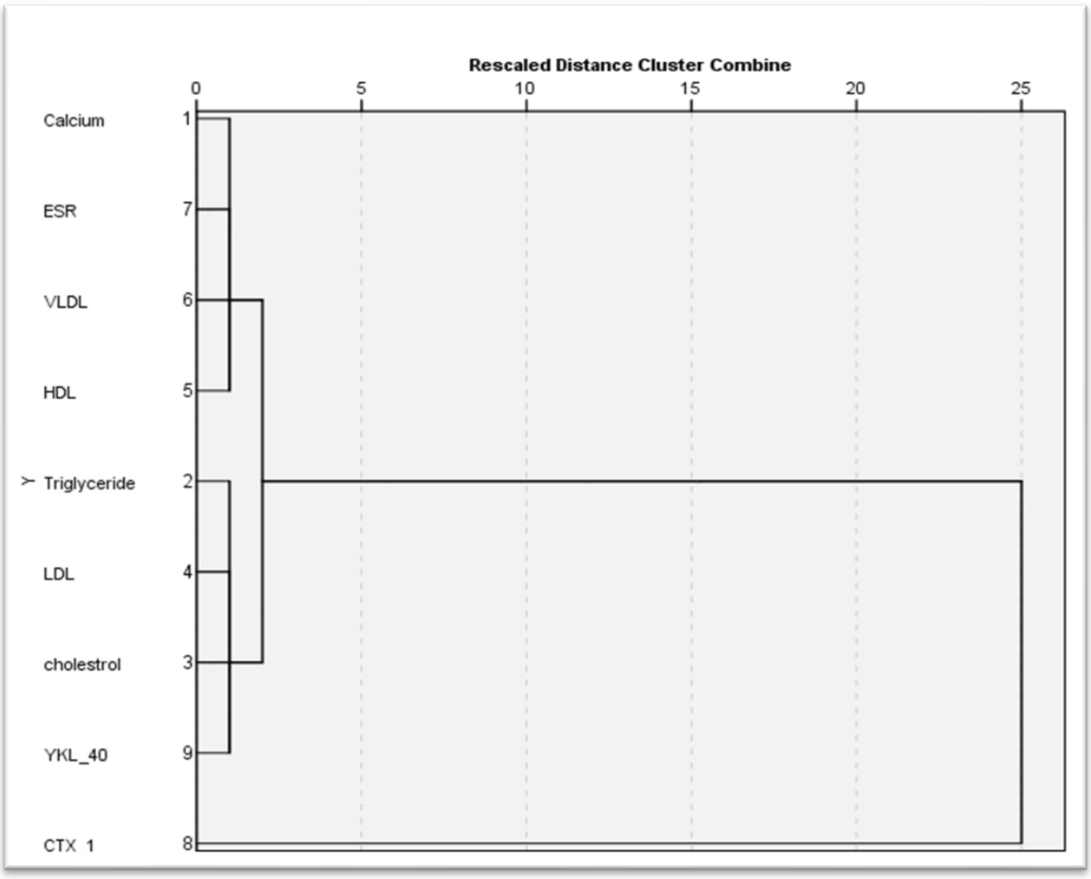

Chart 2. Cluster analysis of variables (Calcium, Triglyceride, cholesterol, LDL, HDL, VLDL, ESR, YKL-40, and CTX-1) in the control group.

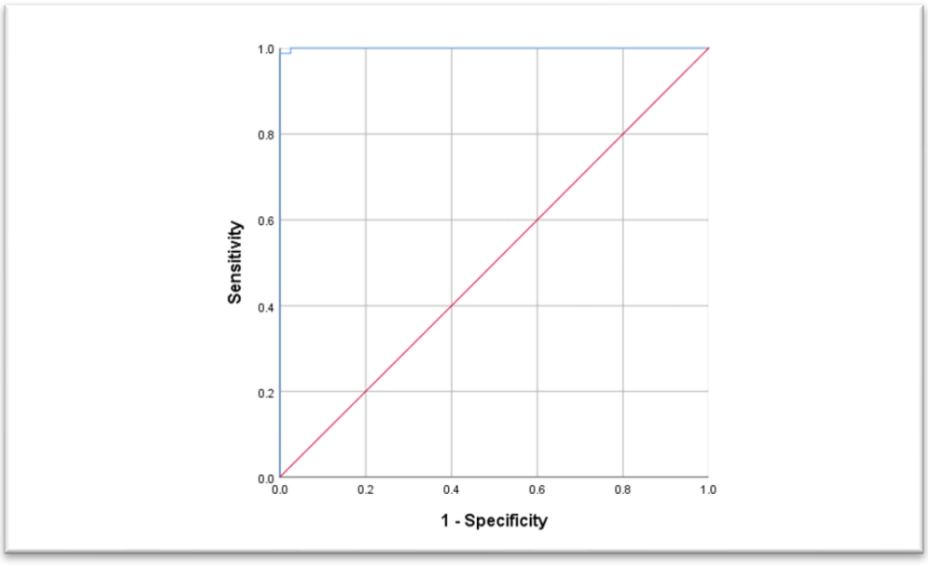

Fig. 2. ROC curve for CTX1 in KOA patients.

The presented results showed the effect of Age on KOA patients ($p \leq 0.01$), the results were highly significant and this agrees with Sacitharan P K.[26] Similar results have been indicated by Valdes A M, study.[27] The inflammatory biomarker ESR was non-significant in the KOA patients and controls,

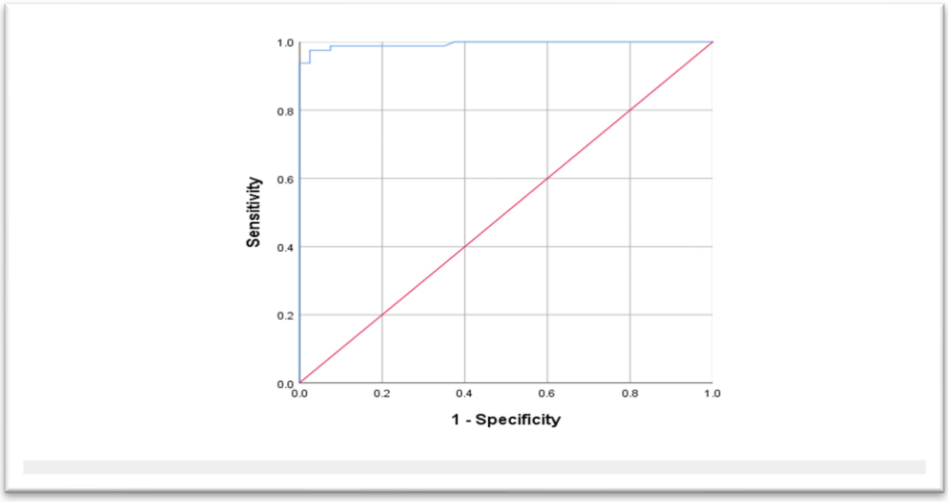

Fig. 3. ROC curve for YKL-40 in KOA patients.

the wide range of inflammatory biomarker effects, which are enhanced in other disorders like rheumatoid arthritis, ESR cannot be employed as specific biomarkers for OA disease,[28] in Roshidah, et al.[29] study showed that fibrinogen increases with an increase in the rate of ESR. In return the result of Mutar H S, *et al.*[2] proved the relation between ESR, and Ca with OA patients, which made it not a specific biomarker for OA disease. BMI body mass index showed non-significant. Calcium levels in serum also were Non-significant with OA cases, this agrees with Chen Y, *et al.*[30] who indicated no relationship between Ca and OA. In contrast, the levels of lipid profile in serum showed high significance between KOA patients and the control group. In the study of Peng *et al.*[31] higher TG levels are associated with greater inflammation in OA patients. Chondrogenesis and endochondral osteogenesis are both critically dependent on cholesterol. As osteoarthritic cartilage exhibits substantial down-regulation of the expression of the cholesterol efflux gene relative to normal cartilage, several prior investigations have shown correlations between inflammation and disequilibrium in cholesterol homeostasis.[32,33] In addition, vascular damage, which impairs blood flow to the subchondral bone, is possible when there is an accumulation of joint cholesterol. Histopathology and the development of OA can occur when cartilage loses nutrition and oxygen.[34,35] Herrero-Manley L, *et al.*[36]. confirmed the effect of Cholesterol, LDL, and TG in OA patients. Thair, *et al.*[37] found that in OA patients, there was a substantial decrease in HDL levels and an increase in TGs, TC, and LDL levels. They connected reduced bone mineral density to these notable discrepancies.

Conclusion

In conclusion, elevated levels of CTX-1 and YKL-40 in KOA patients' serum can indicate severe cartilage degradation when stress-inflammatory conditions are present in these patients. Based on the results gathered in this investigation and the prior studies, it is safe to assume that CTX-1 and YKL-40 can be employed as specific and sensitive biomarkers for KOA disease.

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Authors' declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for republication, which is attached to the manuscript.
- Authors sign on ethical consideration's approval.
- No animal studies are present in the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee at University of Baghdad

Authors' contribution statement

B. F. H. was responsible for concept and design of the research also performed the revision and proof-reading the manuscript. A. R. M was responsible for data acquisition, analysis, and the interpretation of the results.

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دور النوع الأول من الكولاجين المتصالب (CTX-1) والبروتين السكري الغضروفي البشري(YKL-40) في مصول المرضى العراقيين المصابين بالفصال العظمي في الركبة

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الخلاصة

من الشائع حدوث التهاب المفاصل في الركبة(KOA) ، المعروف بمرض الفصال العظمي، بسبب البلى وفقدان الغضروف المفصلي الذي قد يحدث بمرور الوقت وغالبا ما يؤثر على كبار السن .نظرا لأن الغضروف هو العنصر الرئيس الذي قد ينهار عند حدوث الفصال العظمي، يمكن استغلال مكوناته الكيميائية لتطوير علامة حيوية حساسة لتحديد بداية وتطور مرض الفصال العظمي. هدفت الدراسة إلى تقييم وتقدير التغير في مستوى الكولاجين من النوع الأول-C telopeptide (CTX-1)، والبروتين السكري الغضروفي البشري (YKL-40) في عينات المصل التي تم الحصول عليها من (81) مريضا تم تشخيص إصابتهم بالتهاب مفصل الركبة (KOA) الذين تم ادخالهم الى مشفى بغداد في مدينة بغداد الطبية ، للفترة من نيسان 2023 إلى تموز2023 ، تمت مقارنة النتائج المختبرية بين هذه المجموعة و مجموعة من الافراد الاصحاء سريرياً(40 شخص), تم ملاحظة فروقات احصائية مستوى CTX-1 , YKL-40 , HDL, LDL , VLDL , TG والكوليسترول في مرضى التهاب المفاصل في الركبة (KOA) بالمقارنة مع مجموعة الضبط .($p\leq0.01$). في الوقت نفسه، لم يكن هناك فرق ذو دلالة إحصائية بين المجموعتين في مؤشر كتلة الجسم, أيون الكالسيوم, و سرعة تثفل كريات الدم الحمراء ESR حيث كانت ($P>0.05$). وفقا لتحليل الانحدار اللوجستي الثنائي، تم إظهار ارتباط ذو دلالة إحصائية بين انتشار KOA و(CTX-1 ، YKL-40) تحت نتائج منحنى ROC ، أظهر CTX-1منطقة تحت المنحنى (AUC) تبلغ 1.00 ، في YKL-40 كانت 0.994 عند الأشخاص الذين يعانون من الفصال العظمي في الركبة. استنتج من هذه الدراسة، يمكن اعتبار مستويات مصل CTX-1 و YKL-40 علامات جديرة بالثقة يمكن استخدامها بشكل موثوق لتشخيص مرضى التهاب المفاصل بالركبة.

الكلمات المفتاحية: العمر, CTX-1, التهاب المفاصل الركبة, ملف الدهون,YKL-40