Original Article

Type 2 Diabetes Mellitus and Knee Osteoarthritis among a Sample of Geriatric People in Babil 2024

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Abstract

Background: Osteoarthritis (OA) and diabetes mellitus (DM) are two distinct chronic conditions that can significantly impact an individual's quality of life, there is evidence suggesting an interrelationship between the two, particularly with regard to their effects on the musculoskeletal and metabolic systems. **Aim of the Study:** The aim of this study was to study the rate of knee OA in elderly patients with type 2 DM (T2DM) in comparison to nondiabetic controls and to study the impact of DM on OA. **Patients and Methods:** A case–control study was conducted at the geriatric care unit in Merjan Teaching Hospital and Al-Iskenderia Hospital in Babil/Iraq. The study included 50 patients; known cases of T2DM, whose ages range between 60 and 80 years old who were randomly enrolled in the study. The control group consists of 50 patients nondiabetics, matched for age with the patients' group. The Kellgren and Lawrence system was used to classify the severity of OA. **Results:** Diabetic patients had a higher rate of knee OA compared to the control group, with 84% of patients affected by OA, there was no significant correlation between OA severity and key variables such as HbA1c, fasting blood sugar, or body mass index, there was no significant association between glycemic control and OA progression. **Conclusions:** Old-age patients with T2DM had a higher rate of OA compared with nondiabetic controls. T2DM can be considered a predictor for the development of OA of the knee independent of age and other known risks for OA. These findings strengthen the concept of a strong metabolic component in the pathogenesis of OA.

Keywords: Diabetes mellitus, geriatrics, osteoarthritis

Introduction

Osteoarthritis (OA) and diabetes mellitus (DM) are two distinct chronic conditions that can significantly impact an individual's quality of life. Despite being different in terms of their pathophysiology, there is evidence suggesting an interrelationship between the two, particularly with regard to their effects on the musculoskeletal and metabolic systems.[1]

Osteoarthritis

OA is a degenerative joint disease characterized by the breakdown of articular cartilage, leading to joint pain, stiffness, and loss of function. It is primarily associated with aging but can also be influenced by factors such as obesity, joint injury, genetics, and mechanical stress. The pathophysiology of OA involves cartilage degradation, synovial inflammation, subchondral bone sclerosis, and osteophyte formation. Over time, this leads to reduced joint mobility and chronic pain.[2]

The disease typically affects weight-bearing joints such as the knees, hips, and spine, but can also involve smaller joints, such as those in the hands and fingers. Clinical manifestations include joint pain that worsens with activity, stiffness, particularly after periods of rest, and sometimes swelling. Radiographic findings in OA often show joint space narrowing, osteophyte formation, and subchondral bone sclerosis.[3]

Diabetes mellitus

DM, particularly type 2 diabetes, is a metabolic disorder characterized by chronic hyperglycemia resulting from either insulin resistance or insufficient insulin secretion. Over time, persistent hyperglycemia can lead to a wide array of complications, including cardiovascular disease, neuropathy, nephropathy, and retinopathy.[4]

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In individuals with diabetes, the presence of hyperglycemia can negatively impact the joints, contributing to a higher incidence of OA.

1. Hyperglycemia and Advanced Glycation End Products (AGEs): High blood sugar levels promote the formation of AGEs, which can accumulate in tissues, including cartilage. AGEs alter the structure and function of collagen and other matrix components in cartilage, making it more prone to degeneration[5]
2. Obesity and Mechanical Stress: Obesity is a common comorbidity of type 2 diabetes, and excess body weight places additional mechanical stress on joints, particularly the knee. The combination of inflammation associated with both OA and diabetes further accelerates the degenerative process[6]
3. Inflammation: Both OA and diabetes are associated with chronic low-grade inflammation. In diabetes, inflammation is driven by insulin resistance, hyperglycemia, and adiposity, while in OA, it results from cartilage degradation and synovial inflammation. This chronic inflammation can exacerbate both conditions[7]
4. Peripheral Neuropathy: Diabetes can cause peripheral neuropathy, which reduces sensation and proprioception in the extremities. This can alter gait and increase the risk of joint injury and degeneration, particularly in the lower extremities.[8]

Interrelationship between osteoarthritis and diabetes

The coexistence of OA and diabetes can lead to a vicious cycle of joint degeneration and metabolic dysregulation. Patients with diabetes often experience greater pain and functional impairment from OA, and conversely, the limitations caused by OA can make it more difficult for individuals to engage in physical activity, leading to worse glycemic control and increased obesity, further exacerbating both conditions.[9]

Aim of the study

This study was conducted to study the rate of knee OA in elderly patients with type 2 DM (T2DM) in comparison to nondiabetic controls.

Patients and Methods

Study design and setting

A case–control study was conducted at the geriatrics unit in Merjan Teaching Hospital and Al-Iskenderia Hospital in Babil Governorate/Iraq, during the period from July 2024 to the end of December 2024.

Inclusion criteria of the patients

1. Age between (60 and 80) years
2. Patients with T2DM and on treatment for ≥ 6 months.

Exclusion criteria of the patients and control

1. Age <60 years
2. Patients with inflammatory and autoimmune disease (SLE and RA)
3. Patients with known malignancy
4. Patients who underwent knee surgery or have history of previous local injection to the knee joint
5. Patients with a history of knee trauma
6. Postinfectious arthropathy
7. Patients with gout and pseudo gout crystals disease
8. Patients with known endocrine disorders (acromegaly, thyroid disease, and Cushing syndrome).

Controls

The control group included men and women aged ≥60 years nondiabetic according to the American Diabetes Association guidelines for the diagnosis of DM,[10] with symptomatic knee OA as defined by confirmed by radiograph for the target knee joint and staged by Kellgren and Lawrence staging scale,[11] the control matched for age and sex with the diabetic group, after obtaining their verbal consent.

Data collection

Data were collected using a sheet containing questionnaire, the questionnaire included general sociodemographics data: age, gender, marital status, educational level, occupation, smoking (active, passive, x-smoker, non), and history of alcohol drinking.

Measurement of height in meters (m) without shoes using a stadiometer, and weight was measured in kilogram (kg), patients were weighed on a scale, wearing light clothes and without shoes. Body mass index (BMI) was calculated according to the following equation:

- BMI = (Weight in kilogram divided by the square of height in meters)

The sample of patients group consisted of T2DM patients followed at the geriatrics unit. Disease characteristics were collected through the standardized questionnaire including duration of the disease and type of drug treatment for diabetes (classified as no drug use, use of oral antidiabetics, isolated insulin use or combined use of insulin and oral antidiabetics). Also, questionnaire include presence of co-morbidities and complications, family history, and dietary control.

The severity of OA was assessed according to Kellgren–Lawrence (KL) grading system. The KL uses four radiographic features: joint space narrowing, osteophyte, subchondral sclerosis, and deformity.

The severity of radiographic changes increases from grade 0 to grade 4 with grade 0 meaning no radiographic features of OA, while grade 4 means large osteophyte-marked joint space narrowing, severe sclerosis, and definite bony deformity.[12]

X-rays were taken for both knee joints for all patients and controls if obvious differences were present between knees, the most severely affected one's grading was recorded.

Ethical approval

Patients' verbal consents were obtained before participation in the study.

Data and information of the participants were kept confidentially and each personal or private information that identify the participant was kept secret.

Statistical analysis

Data of the patients in both studied groups were entered and analyzed with the aid of Statistical Package using SPSS Inc., (Chicago, IL, USA). Descriptive statistics were presented as frequencies, proportions, mean, and standard deviation accordingly.

Pearson's and Spearman's Rho correlation tests between OA grading according to Kellegren–Lawrence score and demographic variables in both diabetics and control groups. The correlation coefficient (*r*) was calculated and its value ranged between 0 (completely no correlation) and 1 (perfect correlation), the higher r value between 0 and 1 indicated a stronger association; (−) sign refers to inverse (negative) correlation while the nonsigned (+) (*r*) refer to direct (positive) correlation. *P* value was considered to be significant if <0.05.

Results

The majority of patients (54%) and controls (46%) are aged between 71 and 80 years. The mean age of diabetic patients is 75.26 years, slightly higher than the 73.68 years observed in the control group. Regarding gender, 70% of the diabetic patients are female, whereas 80% of the control group are female, meaning the patient group has a lower proportion of females as shown in [Table 1].

Most patients and controls were overweight or obese. The average BMI of diabetic patients is 30.67, which is lower than the average BMI of 33.75 in the control group [Table 1].

The duration of diabetes in the majority of patients (62%) is between 1 and 10 years, while 10% of patients have had diabetes for <1 year and 28% have had it for more than 10 years. A significant portion of diabetic patients (68%) have a family history of diabetes, indicating a genetic predisposition, 96% of the diabetic patients have a fasting blood sugar level >126 mg/dl, which suggests that most patients have poorly controlled diabetes [Table 2].

84% of the diabetic patients have OA, while 62% of the control group have OA. When examining the X-ray grading, 16% of the diabetic patients have normal knee X-rays, compared to 38% of the control group. A higher percentage of diabetic patients have Grade 2 OA (40%) compared to controls (22%), indicating that OA is more moderate in the diabetic group. There are fewer diabetic patients with Grade 3 OA (10%) compared to controls (4%). No diabetic patients have Grade 4 OA, whereas 2% of controls have Grade 4 OA. The $P = 0.94$ suggests that there is no significant difference between the patient and control groups [Table 3].

The correlation between age and OA grade is weak and nonsignificant in both the control and diabetic groups, with $P = 0.61$ for controls and 0.65 for diabetics. Gender also shows no significant correlation with OA grade, with $P = 0.23$ for controls and 0.26 for diabetics [Table 4].

BMI shows no significant correlation with OA grade in the control group ($P = 0.75$) and a weak, nonsignificant correlation in the diabetic group ($P = 0.25$). Finally, the HbA1c level shows no significant correlation with OA grade in either group, with $P = 0.71$ for controls and 0.23 for diabetics [Table 4].

Discussion

The current study results show that 84% of diabetic patients had knee OA compared to 62% of the control group. The higher OA prevalence in diabetic patients is consistent with findings from other studies.

Similar to our study results, a study by Dubey *et al*. that used a large population sample also found no significant association between diabetes and the rate of knee OA. The study highlighted that while diabetes is strongly associated with the prevalence and severity of knee OA, the age of onset did not significantly differ between diabetic and nondiabetic individuals.[13]

Table 1: Basic sociodemographic characteristics of diabetic patients versus control

Variable	Patients (*n*=50), *n* (%)	Controls (*n*=50), *n* (%)
Age (years)		
60–70	10 (20)	15 (30)
71–80	26 (54)	23 (46)
>80	14 (26)	12 (24)
Mean±SD	75.26±7.99	73.68±6.27
Gender		
Male	15 (30)	10 (20)
Female	35 (70)	40 (80)
Education		
Illiterate	19 (38)	15 (30)
Primary	14 (28)	17 (34)
Secondary	11 (22)	13 (26)
College, postgraduate	6 (12)	5 (10)
Smoking		
Nonsmoker	42 (84)	38 (76)
Smoker	8 (16)	12 (24)
BMI (kg/m^2)		
Normal	3 (6)	3 (6)
Overweight	20 (40)	12 (24)
Obese	18 (36)	10 (20)
Morbid obesity	9 (18)	25 (50)
Mean±SD	30.67±4.1	33.75±5.7
Marital status		
Single	1 (2)	1 (2)
Married	44 (88)	48 (96)
Widow	3 (6)	1 (2)
Divorced	2 (4)	0

SD: Standard deviation, BMI: Body mass index

Table 2: Clinical characteristics of diabetes mellitus patient

Variable	Frequency (%)
Duration of DM (years)	
<1	5 (10)
1–10	31 (62)
>10	14 (28)
Family history of DM	
No family history	16 (32)
Positive family history	34 (68)
Associated comorbidities	
Absence	25 (50)
Presence	25 (50)
Type of treatment	
None/diet	2 (4)
Oral hypoglycemic agents	38 (76)
Insulin	7 (14)
Combination	3 (6)
HbA1bc level	
<6.5	1 (2)
>6.5	49 (98)
FBS	
<126	2 (4)
>126	20 (96)

HbA1c: Glycated hemoglobin, FBS: Fasting blood sugar, DM: Diabetes mellitus

Table 3: Knee osteoarthritis rate and X-ray grading according to Kellgren–Lawrence Scale

X-ray	Patient, *n* (%)	Control, *n* (%)	*P*
Normal	8 (16)	19 (38)	0.94
Grade 1	17 (34)	17 (34)	
Grade 2	20 (40)	11 (22)	
Grade 3	5 (10)	2 (4)	
Grade 4	0	1 (2)	
OA rate	42 (84)	31 (62)	

OA: Osteoarthritis

Table 4: Result of Pearson's and Spearman's Rho correlation tests between Kellegren–Lawrence score and demographic variables in controls and diabetics

Variables	OA grade controls	OA grade diabetics
Age (yeas)		
R	−0.033	0.057
P	0.61	0.65
Gender		
R	−0.258	−0.25
P	0.23	0.26
BMI		
R	−0.115	−0.111
P	0.75	0.25
HbA1c		
R	−0.06	−0.092
P	0.71	0.23

BMI: Body mass index, OA: Osteoarthritis, HbA1c: Glycated hemoglobin

A study by Kendzerska *et al*. concluded that OA may increase the risk of developing DM in suspectable individuals, this association was partially explained by walking limitation and OA-related functional limitations which may shift the lifestyle of the patient toward a more sedentary activity.[14]

The current study found that most diabetic patients (62%) have had diabetes for 1–10 years, and 68% have a positive family history of diabetes. However, the study did not show a significant correlation between the duration of diabetes and OA severity.

Issa and Griffin followed 927 men and women aged 40–80 over 20 years. While it found that type 2 diabetes is an independent predictor for severe OA, they also concluded that the difference needs years to be significant and it was more obvious with advanced OA and when the sample are patients requiring interventions such as arthroplasty, their results also did not show a significant difference in the age of onset of OA between diabetic and nondiabetic and no association with duration of diabetes.[12]

Although the current study did not find a significant correlation between HbA1c levels and OA severity, existing research suggests that poor glycemic control is associated with an increased risk of OA progression in diabetic patients.

A study by Chen *et al*. investigated the relationship between poor glycemic control and the risk of OA in type 2 diabetic patients. The study found that patients with poorly controlled blood sugar (defined as an HbA1c level above 7%) had a higher likelihood of developing OA, particularly in weight-bearing joints such as the knees. The research suggests that long-term hyperglycemia can contribute to joint degeneration.[15]

Another study by Neumann *et al*. concluded that DM seems to be a risk factor for developing early OA with an accelerated degeneration of the articular cartilage in the knee.[16]

Most of the study sample patients from both groups were overweight and obese, the association between weight, BMI, and OA is well-documented, indicating that both increased weight and higher BMI are significant risk factors for the development and progression of OA due to increased mechanical load, elevated levels of inflammatory markers such as C-reactive protein and interleukin-6 have been associated with higher BMI.[17]

Higher BMI is associated with more severe OA symptoms and greater functional impairment, patients with higher BMI often report more significant pain and reduced mobility.[18]

Weight loss has been shown to reduce symptoms and improve function in individuals with knee OA. Even a modest weight loss of 5%–10% of body weight can result in significant symptomatic relief.[19]

Conclusions

1. Elderly patients with T2DM had a higher prevalence of

OA compared with healthy controls
2. T2DM can be considered a predictor for the development of OA of the knee independent of age and other known risks for OA.

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Conflicts of interest
There are no conflicts of interest.

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