

Analytical Observational Study of Frozen Shoulder among Patients with Diabetes Mellitus

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Abstract

Purpose This study aims to identify the prevalence of frozen shoulder (FS) among diabetic patients and its relation to demographic features.

Methods This observational study of 216 patients randomly included those with diabetes mellitus (DM) attending the Misan Rheumatology and Medical Rehabilitation Department at Al-Sadder Teaching Hospital in Misan Province of Iraq and was conducted during the period from April 2014 to March 2015. Detailed medical histories were taken from patients and scratch test and hemoglobin A_{1c} were used in diagnostic procedure to confirm diagnosis of FS and DM, respectively.

Results The occurrence rate of FS was 11.5% among patients, with a higher prevalence in females versus males. The most commonly afflicted age group was 60 to 70 years old at 33.3%. Dominant shoulder was more commonly affected than nondominant one. DM presented in large number of patients with FS with a prevalence of 90.3% of cases. The onset of FS in patients with DM was most common within the chronic phase of the disease at 32.3 and 33.8% for durations of 1 to 5 and 5 to 10 years, respectively.

Conclusion There is a strong association between DM and FS. Females were more commonly affected than males. Aging increased shoulder disorder distribution with dominant side being mostly affected. Chronic and noncontrolling diabetic patients were more commonly affected.

Level of Evidence This is a Level III, analytical, observational study.

Keywords

- frozen shoulder
- scratch test
- diabetes mellitus
- shoulder joint

Introduction

Frozen shoulder (FS) is a disabling and sometimes severely painful shoulder condition that is commonly managed in a primary care setting.¹ Patients with diabetes mellitus (DM) have a high risk of developing pain or other symptoms from their shoulders.¹ Patients are often diagnosed with DM years after its onset,² which has led some authors to conclude that this diagnostic delay, which is associated with a long period of poor glycemic control, may influence the risk of acquiring a musculoskeletal disorder of the shoulder.^{3,4} The accepted theory is that high blood glucose levels cause excessive glycosylation.⁵ Early diagnosis of DM

may reduce the risk of long-term chronic disability of the shoulder as well as other complications.^{6,7} Some authors have reported an association with duration and disease control (as measured by hemoglobin A_{1c}[HbA_{1c}] and fasting glucose),⁸ while others did not repeat these findings.^{9–11}

Clinically, patients' first experience is a phase of pain, which progresses into a freezing phase when glenohumeral motion is lost, followed by a thawing phase in which pain gradually subsides and most of the lost motion returns.¹² In the freezing phase, the patient often compensates for decreased glenohumeral motion by increased scapulothoracic motion and thus masking the limitations in motion.^{13,14}

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The aim of this study was to identify and evaluate some demographic features of FS patients and to look into the prevalence of FS among diabetic patients and its relation to that features. The hypothesis of the study was that there is a strong association between FS and DM and with specific demographic features.

Methods

This observational study of 216 patients randomly included those with DM attending the Misan Rheumatology and Medical Rehabilitation Department at Al-Sadder Teaching Hospital in the Misan Province, Iraq. It was conducted during the period from April 2014 to March 2015. All patients routinely attended to the hospital for either treatment, screening, evaluation, and/or follow-up as frequently visiting. All patients gave their written consent before taking part in the study.

Detailed descriptive data were taken from patients, including age, gender, affected side, dominance, body mass index (BMI), DM duration, FS onset, and any other advanced medical diseases or history of joint problems or trauma.

Scratch test was used to diagnose FS by instructing a patient to scratch his medial side of the opposite scapula in three-step direction: from above the same side, from above and across the neck, and lastly from below, and patients unable to complete any of these steps (i.e., with limitation in all directions of movements), with 50% limitation of movement including active and passive external rotation of the involved shoulder in comparison to the other shoulder, or $> 30^\circ$ limitation in movement in cases of bilateral FS.

Diagnosis of DM was confirmed by analysis of HbA_{1c}, which was measured for all patients by Hb electrophoresis using an Hb-variant device with 1 mL of blood with ethylenediamine-tetraacetic acid. According to World Health Organization (WHO) criteria for controlling DM, the HbA_{1c} level should be $\leq 7\%$.¹⁵ An HbA_{1c} level above 6.5%, or ≥ 48 mmol/mol according to the International Federation of Clinical Chemistry standard (IFCC), was set as the cutoff point for diagnosing DM. Patients with an HbA_{1c} level above 6.0% (IFCC ≥ 42 mmol/mol) were defined as having a high risk of developing DM.¹⁵

Patients with slow onset of shoulder pain, unable to complete any of the steps of the scratch test, were included in the study. Patients with all other potential causes of FS other than DM were excluded (i.e., history or local trauma, stroke, advanced pulmonary diseases, advanced cardiovascular diseases, thyroid diseases, and Parkinson's diseases, presence of other coexisting pathology such as glenohumeral osteoarthritis, rotator cuff pathology, calcifying tendinitis, post-surgical stiffness).¹⁶ Other causes of shoulder pain and stiffness were ruled out by X-rays and magnetic resonance imaging.¹⁷⁻¹⁹

Descriptive data were analyzed using standard deviation, standard error, mean, and confidence interval at 95%.

Results

The rate of occurrence was 11.5%, with 216 individuals suffering from shoulder disorder out of 1,884 patients attending to the Misan Rheumatology and Medical Rehabilitation

Table 1 Prevalence of frozen shoulder in relation to age

Age (years) ^a	N	%
<30	6	2.8
31-40	12	5.5
41-50	51	23.6
51-60	60	27.8
61-70	72	33.3
71-80	12	5.6
>80	3	1.4
Total	216	100

Abbreviations: CI, confidence interval; SD, standard deviation; SE, standard error.

^aMean = 30.9; SD = 29.0; SE = 7.75; 95% CI = 4.0-57.7.

Department at Al-Sadder Teaching Hospital in Misan. Females were more commonly afflicted than males at a 3:2 ratio (126:90). Regarding age, the most common rate of occurrence was between 60 and 70 years old at 33.3%, and lowest in the age group above 80 years at 1.4% (**►Table 1**).

The right side most commonly exhibited shoulder joint disorder at 73.6%, while the left side presented with 26.4%. The frequency in the dominant joints (81.9%) was higher than within nondominant (18.1%).

The diabetic patients represented a majority in the sample population (195 patients, 90.3%). Regarding the prevalence of FS according to the duration of DM, the highest frequencies were observed within the chronic phase of the disease at 32.3 and 33.8% for durations of 1 to 5 and 5 to 10 years, respectively (**►Table 2**). A normal distribution was observed for prevalence of FS according to BMI (**►Table 3**).

Discussion

Regarding most events obtained during analytical processing, shoulder disorders represent a high percentage of joint problems in rheumatology despite it being a nonbearing weight joint. Particularly, FS represented 11.5% of all patients that attended this branch of the hospital. Months or years did

Table 2 Prevalence of frozen shoulder according to the duration of DM

Duration of DM (years) ^a	N	%
<1	3	1.5
1-5	63	32.3
5-10	66	33.8
10-15	42	21.5
15-20	15	7.7
>20	6	3.1
Total	195	100

Abbreviations: CI, confidence interval; DM diabetes mellitus; SD, standard deviation; SE, standard error.

^aMean = 32.5; SD = 28.4; SE = 8.19; 95% CI = 9.8-55.2.

Table 3 Prevalence of frozen shoulder in relation to BMI

BMI (kg/m ²) ^a	N	%
20–22	0	0
22–24	18	8.3
24–26	44	20.4
26–28	50	23.1
28–30	20	9.3
30–32	36	16.7
32–34	24	11.1
34–36	18	8.3
36–38	6	2.8
Total	216	100

Abbreviations: BMI, body mass index; CI, confidence interval; SD, standard deviation; SE, standard error.

^aMean = 24; SD = 16.6; SE = 3.92; 95% CI = 13.1–34.8.

not affect the occurrence rate of shoulder disorder presentation. According to the methods used in the diagnosis of FS, the scratch test was reported having high sensitivity and specificity in the diagnosis of FS.^{2,13,20,21}

In the present study, FS affected women more than men and the age groups of the fifth, sixth, and seventh decades at 23.6, 27.8, and 33.3%, respectively. The explanation might be that the patients analyzed in our sample were users of the public health system. As these patients are generally from low socioeconomic levels, one can assume that they may have less control over their conditions, which could justify the high prevalence rate. Arkkila and Gautier demonstrated that the greater prevalence of shoulder involvement in females and the elderly can be explained by the association between old age and adhesive capsulitis.⁷ The preponderance of shoulder complaints in females' patients was also noted by Laslett et al and Cagliero et al.^{3,4} Because human collagen undergoes progressive changes with age that are characterized by changes in color (yellowing), insolubilization, and resistance to digestion by proteolytic enzymes, these age-related changes are accelerated with time.²⁰ FS was also more common in the dominant side, probably due to increased levels of exercises and usage.^{13,14}

About 90.3% of FS patients in the present study were diabetic, which in the most chronic phase of disease was 32.3 and 33.8% for durations of 1 to 5 and 5 to 10 years of diagnosis, respectively. Diabetes plays an important role in the affected musculoskeletal system, as it is a systematic disease and a secondary cause of FS in a variety of ways; the metabolic perturbations in diabetes (e.g., glycosylation of proteins, microvascular abnormalities, damage to blood vessels and nerves, and collagen accumulation in skin and periarticular structures) result in changes in connective tissue.²¹ Approximately 10 to 30% of individuals with DM develop adhesive capsulitis and are usually less responsive to treatment.^{2,4,9} Limited joint mobility, which is common for most patients with shoulder symptoms, normally only occurs after years with high glucose levels, which might explain why there was a high prevalence of patients with

diagnosed diabetes.⁹ Therefore, it is of great importance to be aware of the higher observed prevalence of diabetes within the treatment of patients with shoulder symptoms and to recommend the implementation of standard testing for diabetes of all of these patients.

In DM, shoulder problems have been described as the most disabling manifestation of musculoskeletal disorders.²¹ Its mechanism is known to be persistently high levels of glucose that lead to accumulation of advanced glycosylation end products, which form cross-links with collagen, making it inelastic and more subject to degenerative processes.^{20–22} It is estimated that a diabetic patient has at least twice the amount of this type of human collagen than the nondiabetic population of a similar age, and undergo progressive changes affected joint elasticity.²⁰

There are some limitations in this study. Indeed, the study design is of limited value to infer the results to the general population. Therefore, results reflect only area of study, not all regions or other countries.

In conclusion, FS is one of the most common musculoskeletal system dysfunctions. Female suffered more of this problem and old age altered the shoulder disorder distribution in the population. Right and dominant sides were mostly affected by this disorder. There is a strong association between DM and FS and early diagnosis of FS aids in future management.

Conflict of Interest

None declared.

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References

- Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87(01):4–14
- Tabak AG, Jokela M, Akbaraly TN, Brunner EJ, Kivimäki M, Witte DR. Trajectories of glycemia, insulin sensitivity and insulin secretion before diagnosis of type 2 diabetes: an analysis from the Whitehall II Study. *Lancet* 2009;373(9682):2215–2221
- Laslett LL, Burnet SP, Redmond CL, McNeil JD. Predictors of shoulder pain and shoulder disability after one year in diabetic outpatients. *Rheumatology (Oxford)* 2008;47(10):1583–1586
- Cagliero E, Apruzzese W, Perlmuter GS, Nathan DM. Musculoskeletal disorders of the hand and shoulder in patients with diabetes mellitus. *Am J Med* 2002;112(06):487–490
- Gundtoft PH, Kristensen AK, Gulaksen BA, Brandslund I, Vobbe JW, Sørensen L. Prevalence of diabetes mellitus in patients with shoulder symptoms is low. *Dan Med J* 2013;60(10):A4705
- Lebiedz-Odrobina D, Kay J. Rheumatic manifestations of diabetes mellitus. *Rheum Dis Clin North Am* 2010;36(04):681–699
- Arkkila PE, Gautier JF. Musculoskeletal disorders in diabetes mellitus: an update. *Best Pract Res Clin Rheumatol* 2003;17(06):945–970
- Czelusniak P, Walczak TG, Skare TL. Shoulder pain and dysfunction in 150 type 2 diabetes mellitus patients. *Arq Bras Endocrinol Metabol* 2012;56(04):233–237
- Laslett LL, Burnet SP, Jones JA, Redmond CL, McNeil JD. Musculoskeletal morbidity: the growing burden of shoulder pain and

- disability and poor quality of life in diabetic outpatients. *Clin Exp Rheumatol* 2007;25(03):422–429
- 10 Pal B, Anderson J, Dick WC, Griffiths ID. Limitation of joint mobility and shoulder capsulitis in insulin- and non-insulin-dependent diabetes mellitus. *Br J Rheumatol* 1986;25(02):147–151
 - 11 Thomas SJ, McDougall C, Brown ID, et al. Prevalence of symptoms and signs of shoulder problems in people with diabetes mellitus. *J Shoulder Elbow Surg* 2007;16(06):748–751
 - 12 Neviaser RJ, Neviaser TJ. The frozen shoulder. Diagnosis and management. *Clin Orthop Relat Res* 1987;(223):59–64
 - 13 Milgrom C, Novack V, Weil Y, Jaber S, Radeva-Petrova DR, Fines-tone A. Risk factors for idiopathic frozen shoulder. *Isr Med Assoc J* 2008;10(05):361–364
 - 14 Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder. A long-term follow-up. *J Bone Joint Surg Am* 1992;74(05):738–746
 - 15 Fauci AS, Braunwald E, Kasper DL, Hauser SL, Longo DL, Jameson JL. *HARRISON'S a Principles of Internal Medicine*. 17th ed. New York: The McGraw-Hill Companies, Inc.; 2008:1289–1316
 - 16 Cole A, Pavlou P. *Apley's System of Orthopedics and Fractures*. 8th ed. The shoulder and pectoral girdle. In: Solomon L, Warwick D, Nayagan S. London, United Kingdom: Taylor & Francis Group, Ltd; 2001:337–368
 - 17 Zappia M, Di Pietto F, Aliprandi A, et al. Multi-modal imaging of adhesive capsulitis of the shoulder. *Insights Imaging* 2016;7(03):365–371
 - 18 Chi AS, Kim J, Long SS, Morrison WB, Zoga AC. Non-contrast MRI diagnosis of adhesive capsulitis of the shoulder. *Clin Imaging* 2017;44:46–50
 - 19 Carbone S, Napoli A, Gumina S. MRI of adhesive capsulitis of the shoulder: distension of the bursa in the superior subscapularis recess is a suggestive sign of the pathology. *Eur J Radiol* 2014;83(02):345–348
 - 20 Monnier VM, Sell DR, Abdul-Karim FW, Emancipator SN. Collagen browning and cross-linking are increased in chronic experimental hyperglycemia. Relevance to diabetes and aging. *Diabetes* 1988;37(07):867–872
 - 21 Kim RP, Edelman SV, Kim DD. Musculoskeletal complications of diabetes mellitus. *Clin Diabetes* 2001;19:132–135
 - 22 Isdale AH. The ABC of the diabetic hand—advanced glycosylation end products, browning and collagen. *Br J Rheumatol* 1993;32(10):859–861