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*Original Research Article*

# Diabetes Mellitus (DM) and Shoulder Adhesive Capsulitis (AC) - Intricacies, Perspectives and Pearls of Wisdom

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## ABSTRACT

Diabetes Mellitus (DM) is a heterogeneous group of disorders characterized by variable degrees of impaired insulin secretion, insulin resistance and increased glucose production. Adhesive Capsulitis (AC) denotes the painful shoulder joint of insidious onset associated with stiffness due to a tightly contracted shoulder joint capsule with relative absence of synovial fluid.

Shoulder AC is a macrovascular complication of DM, and is more commonly noted in middle aged and elderly diabetics of either sex. In the present study AC among DM was studied encompassing special clinical evaluations like Yergasons test, Speeds test and special investigations like Fasting insulin level and Insulin resistance by HOMA IR method. Glycemic control parameters and Clinical evaluation parameters were followed up for a period of one year.

Our present study brought out clinical wisdom pearls and certain new observations (as highlighted under results and conclusions) which go a long way in better understanding and management of AC in DM and also aid the clinicians further.

***Key words:*** Diabetes Mellitus, Adhesive Capsulitis, Yergasons test, Speeds test, Insulin Resistance.

## INTRODUCTION

Diabetes Mellitus (DM) is a clinical syndrome characterized by hyperglycemia due to absolute or relative deficiency of insulin or its action along with variable degrees of insulin resistance, thus affecting the metabolism of protein, carbohydrates and fat.

Complications of DM include Microvascular and Macrovascular complications. Microvascular complications include Nephropathy, Retinopathy and Peripheral Neuropathy. Macrovascular complications include complications involving Coronary circulation (Myocardial infarction), Cerebral circulation(TIA, Stroke), Peripheral circulation (Claudication, Peripheral vascular disease) and Musculo skeletal involvement in the form of Stiff hand syndrome, Tenosynovitis, Carpal tunnel syndrome, and Adhesive Capsulitis (AC) of shoulder joint.

AC is a condition in which Shoulder capsule become contracted and thickened, characterized by gradually progressive painful restriction of joint movements. Abnormal collagen repair is considered to be the principal pathogenic mechanism for the development of AC. The decreased range of motion is worst in abduction and external rotation while internal rotation is affected least. However the therapy is principally

conservative including mobilization and gentle stretching of shoulder. Prevalence of AC in Diabetic patients is about 17.9% and 7% in Non Diabetics as per the study by Sarkar et al. [1] Thus AC is a common shoulder lesion in Diabetes affecting middle aged and elderly males, females alike. [2]

Thus the present study was specifically aimed to study the association of DM with AC, particularly

(i) To correlate the association of AC with duration of DM and status of glycemic control.
(ii) To analyze the symptomatology.
(iii) To assess the association and impact of other microvascular, macrovascular complications of DM on AC.
(iv) To identify any specific (Left or Right) shoulder joint predilection to AC among Diabetics.

## MATERIALS AND METHODS

The present prospective, observational, follow up study (follow up of 12 months) was performed after obtaining all necessary approvals, in a tertiary care medical college hospital at Mangalore, Karnataka, India. Consecutive 30 patients each were enrolled for study and control group. The Study group comprised of 30 patients with DM (both known and fresh as per the ADA criteria FBS > 126 mg/dL, PPBS > 200 mg/dL) with AC, and the Control group comprised of 30 DM patients without AC. Both the sexes in the age group of 40-60 years were included in the study. However patients with shoulder pain secondary to Thyroid disease, Trauma, Rheumatoid arthritis, Lung cancer, Pulmonary Tuberculosis, Myocardial infarction, Hemiplegia, Post mastectomy were excluded from the present study.

Both the Study and Control groups were subjected to physical examination comprising of General physical examination (including BMI-Body Mass Index), Systemic examination (including Cardiovascular system, Respiratory system, Gastrointestinal system and Central nervous system), Fundus examination, Visual analog scale for shoulder pain assessment, Shoulder joint examination comprising Yergasons test, Speeds test.

**Yergasons test [3]:** Patient resists supination of the forearm while the physician presses on the bicipital tendon.

**Speeds test [3]:** Patient is asked to flex the forearm while the physician provides resistance.

Both the Study and Control groups were investigated as per the investigation protocol which comprised of Fasting blood sugar (FBS), Post prandial blood sugar (PPBS), Glycosylated Haemoglobin (HbA1C), Urine routine examination, Urine for microalbuminuria, Fasting lipid profile (FLP), Serum creatinine, Insulin resistance by HOMA IR method*, C reactive protein (CRP), Thyroid stimulating hormone (TSH), Plain X ray shoulder joint, Chest X ray, ECG.

*HOMA IR = [FBS in mmol x Insulin level in microunits/ml ] / 22.5

Both the groups received standard line of care for DM and conservative management for AC in the study group.

Both groups were followed up at 6 months and 12 months with FBS, PPBS, HbA1C estimation and Physical examination (for pain and range of movement at shoulder).

***Statistical methods:***

All the observations were recorded and conclusions were drawn after statistical analysis using SPSS software 13. Chi square test and Paired differences analysis were performed. P value of <0.005 was considered as significant.

## RESULTS

The following results were obtained from our study.

Mean Age of subjects in the study group was 58 years and 61 years for the control group (Table 1).

Study group comprised of 16 males and 14 females while control group comprised of 20 males and 10 females with no statistically significant correlation (Table 2).

Duration of DM in study group was 8 years and 10 years in control group, with no statistically significant correlation towards development of AC (Table 3).

Pain in the shoulder region during night was the most conspicuous symptom and was seen in 29(96.7%) of patients in the study group with a very high statistical significance (Table 4).

Restricted movement of the shoulder was noted in 32(53.3%) of patients and was statistically very highly significant (Table 5).

Tingling and Numbness of the extremities was noted in 8 patients in the study group while none had in the control group, thus demonstrating a very high statistical significance (Table 6).

Yergasons test and Speeds test were positive in only those who had AC (ie in the study group) and it was statistically significant (Table 7,8).

Body mass index-BMI was identical in both study and control group and did not show any statistical significance with respect to AC (Table 9).

The Fundus examination – Diabetic Retinopathy was present in 14 cases (46.7%) in study group and 11 cases (36.7%) in control group but was not statistically significant (Table 10).

Base line FBS, PPBS, HbA1C were higher in the study group but had no statistically significant relation to AC (Table 11).

There was no statistically significant correlation between Microalbuminuria, Serum creatinine in both study and control groups. Higher serum cholesterol, Higher LDL cholesterol with Lower triglycerides was evident in the study group compared to control group (Table 12).

Strong correlation was observed between C reactive protein (CRP) positivity and AC in our study (Table 13).

Fasting insulin levels were very high in the study group compared to control group and it was statistically highly significant (Table 14).

A statistically significant correlation between AC and Insulin resistance was observed in our study (Table 15).

Paired differences for the followup physical examinations (from base line), with respect to pain & range of movement of shoulder showed statistically significant improvement (Table 16).

Paired differences for the followup glycemic control parameters (FBS, HbA1C) showed a statistically significant control of glycemia in both groups in the form of reduction of FBS, HbA1C (Table 17, 18).

Present study did not show any significant correlation between variables (such as glycemic status, serum lipid levels, renal profile, BMI, insulin resistance) with respect to Right or Left sided AC (Table 19).

**TABLE 1 : AGE PROFILE**

| GROUP | N | Mean | Std deviation | t |
|---|---|---|---|---|
| Age STUDY | 30 | 58.1667 | 9.48714 | 1.23500 |
| CONTROL | 30 | 61.6667 | 12.29054 | P=0.222 ns |

**TABLE 2 : SEX DESTRIBUTION**

| | Study Group | Control Group | Total |
|---|---|---|---|
| SEX Male | 16 (53.3%) | 20 (66.7%) | 36 (60%) |
| Female | 14 (46.7%) | 10 (33.3%) | 24 (40%) |
| TOTAL | 30 (100% ) | 30 (100%) | 60 (100%) |

X2 = 1.111 p = 0.292 ns

**TABLE 3 : DURATION OF DIABETES**

| GROUP | | N | Mean | Standard Deviation |
|---|---|---|---|---|
| Diabetes | Study | 30 | 8.0833 | 5.0957 |
| | control | 30 | 10.255 | 7.24500 |
| | | | | P= 0.185 |

**TABLE 4 : PAIN DURING NIGHT**

| Pain at Night | Study Group | Control Group | Total |
|---|---|---|---|
| YES | 29 (96.7%) | 0 | 29 (48.3%) |
| NO | 1(3.3%) | 30 (100%) | 31 (51.7%) |
| TOTAL | 30(100%) | 30 (100%) | 60 (100%) |

p < 0.001 vhs

**TABLE 5 : RESTRICTED SHOULDER MOVEMENT**

| Movement Restriction | Study Group | Control Group | Total |
|---|---|---|---|
| YES | 30 (100%) | 2 (6.7%) | 32 (53.3%) |
| NO | 0 | 28 (93.3%) | 28 (46.7%) |
| TOTAL | 30(100%) | 30 (100%) | 60 (100%) |

p < 0.001 vhs

**TABLE 6 : TINGLING & NUMBNESS IN PERIPHERIES**

| | Study Group | Control Group | Total |
|---|---|---|---|
| YES | 8 (26.7%) | 0 | 8 (13.3%) |
| NO | 22 (73.3%) | 30 (100%) | 52 (86.7%) |
| TOTAL | 30 (100%) | 30 (100%) | 60 (100%) |

X2 = 9.231 p = 0.002 hs

**TABLE 7 : YERGASONS TEST**

| Yergasons Test | Study Group | Control Group | Total |
|---|---|---|---|
| Negative | 0 | 30 (100%) | 30 (50%) |
| Positive | 30(100%) | 0 | 30 (50%) |
| TOTAL | 30 (100%) | 30 (100%) | 60 (100%) |

**TABLE 8 : SPEEDS TEST**

| Speeds Test | Study Group | Control Group | Total |
|---|---|---|---|
| Negative | 0 | 30 (100%) | 30 (50%) |
| Positive | 30 (100%) | 0 | 30 (50%) |
| TOTAL | 30 (100%) | 30 (100%) | 60 (100%) |

**TABLE 9 : BODY MASS INDEX (BMI)**

| GROUP | N | Mean | Standard Deviation |
|---|---|---|---|
| Study Group | 30 | 23.7897 | 3.67086 |
| Control Group | 30 | 23.9107 | 3.85909 |

P= 0.901

**TABLE 10 : FUNDUS EXAMINATION (RETINOPATHY)**

| Retinopathy | Study Group | Control Group | Total |
|---|---|---|---|
| Absent | 16 (53.3%) | 19 (63.3%) | 35 (58.3%) |
| Present | 14 (46.7%) | 11 (36.7%) | 25 (41.7%) |
| TOTAL | 30 (100%) | 30 (100%) | 60 (100%) |

**TABLE 11 : BASE LINE FBS, PPBS, HbA1C**

| Investigation | Group | N | Mean | Std Deviation | t |
|---|---|---|---|---|---|
| FBS | Study | 30 | 182.2667 | 60.4979 | 1.8780 |
| | Control | 30 | 154.0667 | 55.7283 | P=0.065 ns |
| PPBS | Study | 30 | 227.4333 | 70.6490 | 0.3120 |
| | Control | 30 | 234.5667 | 103.5802 | P=0.756 ns |
| HbA1C | Study | 30 | 8.5067 | 1.2773 | 1.6540 |
| | control | 30 | 7.8167 | 1.8942 | P=0.105 ns |

**TABLE 12 : MICRO ALBUMINURIA, FLP, SERUM CREATININE**

| Lab Test | Group | N | Mean | Std Deviation | t |
|---|---|---|---|---|---|
| Microalbuminuria | Study | 30 | 11.133 | 14.9359 | 0.5260 |
| | Control | 30 | 14.816 | 34.6204 | P=0.601 ns |
| FLP TC | Study | 30 | 204.633 | 37.1896 | 0.2360 |
| | Control | 30 | 201.500 | 62.5166 | P=0.814 ns |
| TG | Study | 30 | 162.100 | 62.4970 | 0.8310 |
| | Control | 30 | 177.600 | 80.8155 | P=0.409 ns |
| HDL | Study | 30 | 43.000 | 19.6633 | 1.7570 |
| | Control | 30 | 32.686 | 18.0680 | P=0.078 ns |
| LDL | Study | 30 | 128.690 | 35.5601 | 0.4710 |
| | Control | 30 | 121.400 | 77.0776 | P=0.64 ns |
| VLDL | Study | 30 | 32.363 | 12.4929 | 0.7260 |
| | Control | 30 | 35.144 | 16.8500 | P=0.471 ns |
| Serum Creatinine | Study | 30 | 1.1070 | 1.0776 | 1.4150 |
| | Control | 30 | 1.6200 | 1.6672 | P=0.164 ns |

**TABLE 13 : C REACTIVE PROTEIN (CRP)**

| CRP | Study Group | Control Group | Total |
|---|---|---|---|
| Negative | 14 (46.7%) | 25 (83.3%) | 39 (65%) |
| Positive | 16 (53.3%) | 5 (16.7%) | 21 (35%) |
| Total | 30 (100%) | 30 (100%) | 60 (100%) |

X2=8.864 p=0.003 hs

**TABLE 14 : FASTING INSULIN LEVEL**

| Group | N | Mean | Std Deviation | t |
|---|---|---|---|---|
| Study | 30 | 31.0441 | 17.8441 | 5.0170 |
| Control | 30 | 12.6248 | 9.2741 | P=0.001 vhs |

**TABLE 15 : INSULIN RESISTANCE – HOMA IR**

| GROUP | N | Mean | Std Deviation | t |
|---|---|---|---|---|
| Study | 30 | 14.3613 | 11.1720 | 4.1030 |
| Control | 30 | 5.1150 | 5.2505 | P=0.001 vhs |

**TABLE 16 : PHYSICAL EXAMINATION – FOLLOWUP PAIRED DIFFERENCES**

| Group | N | Mean | Std Deviation | t | p |
|---|---|---|---|---|---|
| Base line to 1st follow up | 30 | 63 | 11.050 | 2.471 | 0.001 vhs |
| Base line to 2nd follow up | 30 | 98 | 6.156 | 1.376 | 0.001 vhs |
| 1st follow up to 2nd follow up | 30 | 35 | 7.947 | 19.696 | 0.001 vhs |

**TABLE 17 : FBS – FOLLOW UP PAIRED DIFFERENCES**

| Group | Mean | Std Deviation | t | p |
|---|---|---|---|---|
| FBS – FBS 1 | 69.4643 | 57.4794 | 6.395 | 0.001 vhs |
| FBS – FBS 2 | 66.8000 | 58.5865 | 5.099 | 0.001 vhs |
| FBS1– FBS2 | 2.1500 | 12.8402 | 0.749 | 0.463 |

**TABLE 18 : HbA1C – FOLLOWUP PAIRED DIFFERENCES**

| Group | Mean | Std Deviation | t | p |
|---|---|---|---|---|
| HbA1C – HbA1C 1 | 1.1357 | 0.8786 | 6.840 | 0.001 vhs |
| HbA1C – HbA1C 2 | 1.1650 | 1.0006 | 5.207 | 0.001 vhs |
| HbA1C 1 – HbA1C 2 | 0.1750 | 0.41023 | 1.908 | 0.072 |

**TABLE 19 : LEFT & RIGHT AC COMPARISON (In Study Group *)**

| Parameter | Side | N | Mean | Std deviation | t |
|---|---|---|---|---|---|
| FBS | Right | 17 | 181.29 | 69.31068 | 0.186 |
| | Left | 12 | 185.67 | 50.93014 | P=0.854 |
| PPBS | Right | 17 | 225.59 | 71.47994 | 0.311 |
| | Left | 12 | 234.08 | 73.89361 | P= 0.758 |
| HbA1C | Right | 17 | 8.5647 | 1.57676 | 0.181 |
| | Left | 12 | 8.475 | 0.80354 | P=0.858 |
| BMI | Right | 17 | 23.585 | 3.69385 | 0.304 |
| | Left | 12 | 24.02 | 3.93835 | P=0.764 |
| Microalbuminuria | Right | 17 | 7.2353 | 13.21216 | 1.251 |
| | Left | 12 | 13.417 | 12.95059 | P=0.222 |
| FLP Tc | Right | 17 | 204.12 | 32.45744 | 0.118 |
| | Left | 12 | 205.83 | 45.92451 | P=0.322 |
| TG | Right | 17 | 173.65 | 73.37314 | 1.001 |
| | Left | 12 | 149.92 | 43.24866 | P=0.322 |
| HDL | Right | 17 | 40.529 | 8.8679 | 1.385 |
| | Left | 12 | 45.417 | 10.0319 | P=0.177 |
| LDL | Right | 17 | 128.69 | 28.66073 | 0.05 |
| | Left | 12 | 129.38 | 46.17858 | P=0.96 |
| VLDL | Right | 17 | 34.665 | 14.67042 | 0.998 |
| | Left | 12 | 29.933 | 8.64674 | P=0.327 |
| Serum Creatinine | Right | 17 | 1.2882 | 1.40262 | 1.06 |
| | Left | 12 | 0.8508 | 0.27881 | P=0.296 |
| HOMA IR | Right | 17 | 15.89 | 9.39158 | 0.806 |
| | Left | 12 | 12.418 | 13.87034 | P=0.427 |
| Insulin Level | Right | 17 | 34.4638 | 13.66059 | 1.20400 |
| | Left | 12 | 26.2867 | 22.91634 | P=0.239 |

*1 case of Bilateral AC was not considered for group statistics analysis.

## DISCUSSION

AC is a crippling disorder affecting both sexes and more prevalent in diabetic population. Age profile analysis in our study revealed increased prevalence of AC after the age of 40 years in diabetics. This was consistent with other studies. Further no correlation could be established between sex of the patient and development of AC.

Our study highlights the fact that Duration of DM should not be a limiting factor to suspect AC as duration of DM was not significantly different in diabetic subjects with and without AC. This has not been highlighted in any of the earlier studies.

In our present study a high statistical significance was noted for the symptoms of shoulder pain during night and restricted movements of shoulder joint in AC. Thus these two symptoms must be given due credit for diagnosing AC in DM. Such an analysis is however not seen in earlier studies.

In our study high statistical significance was noted for tingling and numbness of extremities in AC. This highlights the need for extra vigilance in

such scenarios to pick up AC. Such associations have not been highlighted in earlier studies.

Our study establishes the fact that Yergasons test and Speeds test must be performed in all suspected cases of AC to confirm the same as a high statistical significance was noted. This has not been highlighted in the literature.

Our study proves that there is no significant correlation between AC and other diabetic microvascular complications like nephropathy and retinopathy. Thus this highlights the need for seeking AC in DM, independent of other diabetic complications. This aspect has not been noted in earlier studies.

Our study proves the fact that uncontrolled DM (higher FBS, PPBS, HbA1C) has a strong correlation for development of AC. The same has been observed by Mavrikakis et al [4] also.

Our study showed higher serum Cholesterol, higher LDL, and lower Triglycerides in study group compared to controls. This was contrary to the finding by Mavrikakis et al, [4] which showed higher Cholestrol and TG levels among DM with AC, compared to DM without AC. Hence this needs further elaborate evaluation in future.

Our study signifies CRP as an important inflammatory marker of AC in DM, as a strong correlation could be established between CRP positivity and AC. Such association has not been proved in earlier studies.

In our present study, high fasting insulin levels and high insulin resistance were associated with AC (with a high statistical significance), thus highlighting the need for such estimations in AC. However no such data is available from earlier studies and literature.

Our study highlights the fact that achieving glycemic control translates itself in to significant improvement of pain and range of movement at shoulder joint. However no such evaluations were evident in earlier studies.

In spite of detailed evaluation and follow up in our study, it was not possible to recognize the predilection towards Left or Right shoulder joint to develop AC in DM. However no such efforts were noted in the earlier studies.

## CONCLUSIONS

Our present study is novel in nature as it incorporated various parameters and factors that have not been studied earlier.

Thus from our present study we conclude the following-

Duration of Diabetes (DM) should not be a limiting factor for suspecting AC.

Extra vigilance is required on the part of care givers to pickup AC in Diabetics having symptom of tingling, numbness of peripheries.

Even though clinical examination tests have variable predictive values, Yergasons test and Speeds test must be performed in all suspected cases of AC.

AC should be sought out (diagnosed) independent of other diabetic complications such as nephropathy and retinopathy.

Special investigations like fasting insulin levels and insulin resistance will be of additional value in diagnosing AC in DM.

Good glycemic control should be aimed for, as it translates itself into significant improvement (both symptomatic and functional) of AC in DM.

Evaluations to identify predilection of specific shoulder joint (Left/Right) to develop AC, donot yield any fruitful results and hence should be discouraged.

The pattern of dyslipidemia in Diabetics with AC in our present study was not consistent with the findings of other researchers. Hence further elaborate studies are needed in this direction.

The above PEARLS OF WISDOM definitely aid clinicians in better understanding, assessing and managing AC in DM.


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