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Prevalence of diabetes mellitus in patients with shoulder symptoms is low

Per Hviid Gundtoft¹, Anne Krogh Kristensen², Birthe Anette Gulaksen², Ivan Brandslund³, Jette Wessel Vobbe² & Lilli Sørensen²

ABSTRACT

INTRODUCTION: Patients with diabetes mellitus have a high risk of developing symptoms from their shoulder. The generally accepted theory is that high blood glucose levels cause excessive glycosylation and that the delay in diagnosing diabetes mellitus may influence the risk of acquiring a musculoskeletal disorder. The aim of the study was to determine whether there was a large percentage of undiagnosed diabetes mellitus in a population of patients with shoulder symptoms.

MATERIAL AND METHODS: The study population consisted of patients who were referred by their GP with shoulder symptoms. HbA_{1c} level was measured, and height, weight, sex, age and diabetes status were registered. Patients with shoulder symptoms were compared to a group of patients who had been referred with knee symptoms and to the regional prevalence of unknown and diagnosed diabetes mellitus. **RESULTS:** A total of 221 patients with shoulder symptoms were included. There was no significant difference in the prevalence of unknown diabetes mellitus between the group of patients with shoulder symptoms and the group of patients with knee symptoms or the regional prevalence. There was a significantly higher prevalence of diagnosed diabetes mellitus in the group of patients with shoulder symptoms.

CONCLUSION: The low prevalence of unknown diabetes mellitus we observed in this study may be owed to the fact that upper extremity disorder often occurs years after onset of diabetes, and for that reason patients have already been diagnosed when the extremity disorder present. This study demonstrates a higher prevalence of diagnosed diabetes mellitus among patients with shoulder symptoms. It is important for physicians to be aware of this in the treatment of patients with shoulder symptoms. **FUNDING:** not relevant.

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Patients with diabetes mellitus have a high risk of developing pain or other symptoms from their shoulders [1-6]. The studies which have shown this association are predominantly observational, and the pathogenic mechanism has not been fully elucidated. The generally accepted theory is that high blood glucose levels in diabetic patients cause an excessive glycosylation of connective tissue [7]. The prevalence of diabetes mellitus is high in both developing and developed countries, and it is estimated that it increases rapidly worldwide [8]. Patients are often diagnosed with diabetes years after its onset [9], which have led some authors to conclude that the diagnostic delay – which is associated with a long period of poor glycaemic control – may influence the risk of acquiring a musculoskeletal disorder of the shoulder [1, 2]. Presumably, early diagnosis of diabetes mellitus – and therefore glycaemic control – may reduce the risk of long-term chronic disability of the shoulder as well as other complications. A population study in Denmark has shown that the prevalence of type 2 diabetes is high and that two out of three go undiagnosed [10].

The aim of this study was to investigate the percentage of undiagnosed or diagnosed diabetes mellitus cases in a population of patients with shoulder symptoms.

MATERIAL AND METHODS

We conducted a cross-sectional study in which newly referred patients had their HbA_{1c} level measured. The inclusion period ran from February to September 2012. The study was set-up to compare two groups of patients: a group with shoulder symptoms (PSS) and a group with knee symptoms (PKS). The patients with knee symptoms were chosen as a control group as diabetes is not associated with symptoms from the knee.

Inclusion criteria were all patients whose general practitioner had recently referred them to the Orthopaedic Department at Hospital of Lillebælt, Vejle Hospital, due to symptoms of either the shoulder or knee.

The exclusion criteria were: injection with corticosteroids within the past four months, age under 18 years, not being able to read or understand Danish, not being a Danish citizen, mental disorder, pregnancy, and musculoskeletal disorder in both the shoulder and the knee.

Information about the study was mailed to patients two weeks before their visit to the hospital. Upon arrival they were informed about the study by a physician, a chiropractor or a physiotherapist. If they agreed to participate, the patient's age, sex, weight, height, and known diabetes mellitus diagnosis were recorded. For patients with shoulder symptoms, we registered the

ORIGINAL ARTICLE

1) Orthopaedic Department, Hospital of Lillebælt, Kolding Hospital 2) Orthopaedic Department, Hospital of Lillebælt, Vejle Hospital 3) Laboratory Centre, Hospital of Lillebælt, Vejle Hospital

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TABLE 1

Clinical characteristics of the patients with knee symptoms and with shoulder symptoms.

	Patients with shoulder symptoms (N = 232)	Patients with knee symptoms (N = 199)	p-value
Male, n (%)	100 (43)	102 (51)	NS
Age, yrs, mean (range)	53 (19-86)	45 (17-74)	< 0.01
BMI, kg/m ² , average (range)	27 (17-51)	27 (16-54)	NS
Known diabetes mellitus, n (%)	20 (9)	6 (3)	0.01
Unknown diabetes mellitus, n (%)	4 (2)	1 (0.5)	NS
HbA _{1c} level > 6.0%, n (%)	22 (9)	6 (3)	0.002
BMI = body mass index; NS = non-significant.			

diagnosis made by the physician, chiropractor or physiotherapist at the first visit. The patients were then asked to give a blood sample to measure their HbA_{1c} level by high-performance liquid chromatography. An HbA_{1c} level above 6.5% (International Federation of Clinical Chemistry standard (IFCC) \geq 48 mmol/mol) was set as the cutoff point for diagnosing of diabetes mellitus. Patients with an HbA_{1c} level above 6.0% (IFCC \geq 42 mmol/mol) were defined as having an elevated HbA_{1c} level and a high risk of developing diabetes mellitus.

All patients gave their written consent before taking part in the survey, and the protocol was approved by the local ethical committee and the Danish Data Protection Agency.

The PSS group was matched 1:5 (on age and body mass index (BMI)) with a similar group from a research database containing information about 5,222 randomly selected inhabitants from the county of Vejle where the Hospital of Lillebælt, Vejle Hospital, is situated. The inhabitants who were invited to be included in the database were randomly picked by a programme using their civil registration number. The database contains information, among others, on HbA_{1c} level measured at the time of inclusion, weight, height, and sex. Approximately 40% of the inhabitants who were invited agreed to participate.

For each patient in the PSS group, we randomly picked five control patients from the database. The patients were matched according to BMI (< 25, 25-30, 30-35, > 35 kg/m^2) and age (five-year intervals).

Data and statistical analysis

We estimated that the percentage of diagnosed and unknown diabetes mellitus in the PKS group was similar to that of the general population. Specifically, we expected to find that 7% were diagnosed with diabetes mellitus and that 10% had previously unknown diabetes mellitus in the PKS group. Furthermore, we expected that twice as many in the PSS as in the PKS would be diagnosed with diabetes mellitus – i.e. 14% – and that twice as many in the PSS group would have an unknown diabetes mellitus – i.e. 20%.

Based on our assumptions, an a priori power analysis estimated that 200 patients were to be included in each group to find a significant difference between the PKS and PSS group.

All analyses were performed with the STATA programme.

Trial registration: not relevant.

RESULTS

A total of 221 patients were included into the PSS group and 199 patients into the PKS group.

The mean age in the PSS group was 53 years, and the participants were predominantly female (57%). The PKS group had a mean age of 46 years, and the participants were predominantly male (51%). In both the PKS and PSS group, the average BMI was 27. The only significant clinical difference between the two groups was age (p < 0.01).

The clinical characteristics of the patients with knee symptoms and with shoulder symptoms are shown in **Table 1**. The most common diseases diagnosed by the physician, chiropractor or physiotherapist according to the Danish version of International Classification of Diseases, 10th edition, (ICD-10) were impingement (DM754) 30%, periarthrosis humeroscapularis (DM750) 14% and calcific tendinitis of the shoulder (DM753) 13%.

Of the eligible patients in the PSS group, 5% were excluded and 34% declined to participate. In the PKS group, 9% were excluded and 32% declined to participate. When compared to the group of patients who were included, relatively more men than women declined to participate and their average age was somewhat lower than that of the included patients.

Prevalence of unknown diabetes mellitus

Four patients (2%) who had not previously been diagnosed with diabetes mellitus in the PSS group were found to have an HbA_{1c} level above 0.065. In the PKS group, only one (0.5%) patient without known diabetes mellitus was found to have an HbA_{1c} level above 0.065. The difference was not significant (p = 0.37), Table 1.

In the matched control group of the regional population, 1.4% had an HbA_{1c} level above 0.065, which is not significantly different from that of the PSS group.

Prevalence of diagnosed diabetes mellitus

In the PSS group, 20 patients (9%) were diagnosed with diabetes mellitus before their visit to the clinic. This was significantly more than in the PKS group where only six patients (3%) were diagnosed with diabetes mellitus (p = 0.01). No significant difference was found when multivariate analysis was performed and the effects of age and BMI were controlled for (Table 1).

In the region where Hospital of Lillebælt, Vejle Hospital, is situated, the prevalence of diagnosed diabetes is 4.1% [11].

Prevalence of elevated HbA_{1c} level

In the PSS group, 22 patients (10%) had an HbA_{1c} level between 6.0 and 6.5 which is more than in the PKS group where only six patients (3%) had an elevated HbA_{1c} level (p = 0.002). When multivariate analysis was performed and the effects of age and BMI were controlled for, the difference was, however, not significant (p = 0.10).

In the matched group from the research database, 9% had an HbA_{1c} level between 6.0 and 6.5 (IFCC \geq 42 mmol/mol), which is not significantly different from that of the PSS group.

DISCUSSION

The study has shown that there is a low prevalence of undiagnosed diabetes, but a high prevalence of diagnosed diabetes mellitus in patients with shoulder symptoms, which is consistent with other reports which have shown a high prevalence of shoulder symptoms in patients with diabetes mellitus [1-4, 12].

Much to our surprise, we did not find a higher proportion of unknown diabetes mellitus in patients with shoulder symptoms than in patients with knee symptoms or in the general population. Limited joint mobility, which is common for most patients with shoulder symptoms, normally only occurs after years with a high glucose level [1, 13, 14], which may possibly explain why only a few patients in the shoulder group remained with an undiagnosed diabetes while there was a high prevalence of patients with diagnosed diabetes.

The reason for the low prevalence may be that the awareness of diabetes and the importance of early diagnosing may have increased during the past decade reducing the prevalence of unknown diabetes in Denmark as compared to the prevalence observed in 2003 [10].

Diagnosis of unknown diabetes is of much importance as early treatment can reduce the risk of complications. Patients with shoulder symptoms are often treated with injections of corticosteroid which can have serious adverse effects in patients with diabetes mellitus. Therefore it is of great importance to be aware of the observed higher prevalence of diabetes in the treatment of patients with shoulder symptoms, but we did, however, not find sufficiently strong reasons to recommend the implementation of standard testing for diabetes of all patients with shoulder symptoms.

A limitation of the present study was that 33% of

the eligible patients declined to participate. As a result of this, we cannot exclude that self-selection may have occurred, which possibly caused either an overrepresentation of individuals with an interest in diabetes mellitus or an underrepresentation of individuals with a high risk of diabetes mellitus, but an apprehension towards being diagnosed with diabetes mellitus.

Another limitation of this study is that we did not exclude shoulder symptoms that are not directly associated with diabetes mellitus. The reason why we included all patients with shoulder symptoms was that limited joint mobility is common among almost all patients referred with shoulder symptoms and that the aim of the study was to investigate the prevalence of unknown diabetes in patients with shoulder symptoms regardless of their diagnosis. However, this inclusion of all patients with shoulder symptoms might lead to an overrepresentation of individuals who do not have a high risk of diabetes mellitus because their shoulder disability is not directly associated with diabetes, e.g. bankart lesion, shoulder impingement, etc. Further research into those shoulder symptoms which are directly related with diabetes, e.g. frozen shoulder [15], is needed to elucidate the association between the shoulder symptoms and the prevalence of unknown diabetes, the duration and the type of diabetes. Investigation of these questions calls for larger sample sizes and multicentre trials.

CONCLUSION

The prevalence of undiagnosed diabetes in patients with shoulder symptoms is not higher than the prevalence in patients with other symptoms or than prevalence in the general population. However, there is a high prevalence of diagnosed diabetes mellitus among patients with shoulder symptoms. This may possibly be explained by the fact that limited joint mobility only occurs years after the onset of diabetes why patients have often been



Physical shoulder examination. diagnosed with diabetes before they experience symptoms from their shoulder. As patients with shoulder symptoms are often treated with injections of corticosteroids, we stress the need for awareness of the high prevalence of diabetes (> 10%) in this group of patients.

CORRESPONDENCE: Per Hviid Gundtoft, Ortopædisk Afdeling, Kolding Sygehus, 6000 Kolding, Denmark. E-mail: peargun@gmail.com ACCEPTED: 17 July 2013

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