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Rate of Glycemic Control and Prevalence of Associated Complications in Riyadh, Saudi Arabia 5 years Retrospective Chart Review of Adults in a tertiary care hospital and Primary Healthcare Clinics Among Adults with Type 2 Diabetes Mellitus Over 5 Years Period in Riyadh, Saudi Arabia

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Abstract

Background: *Diabetes Mellitus Type 2 and its associated complications are highly prevalent in Saudi Arabia and are linked to duration of disease and disease control. This study aims to study the rate of glycemic control and diabetes associated complications among patients in Riyadh, Saudi Arabia.*

Methods: *this is a 5-year retrospective chart review including 319 diabetic patients in a tertiary care center and linked primary healthcare clinics in Riyadh, Saudi Arabia from January 2016 to December 2020.*

Results: *of the 319 patients included, 58.6% were females (n=187). Mean age was 67.74± 12.63 years. Mean HgA1c during the study period was 8.30 mmol/L± 1.9. 9.1% had myocardial infarction, and of those screened 29.9% and 15% had microalbuminuria and retinopathy, respectively. 7.2% had neuropathy. 2.2% had diabetic foot and of those 42.9% progressed into amputation. Mortality was 6% over the study period.*

Conclusion: *Our study found the control of diabetes mellitus in a tertiary care center and primary care clinics to be suboptimal, with a significant association between HbA1c levels and LDL level control, retinopathy, and neuropathy among type 2 diabetic patients in Saudi Arabia. More research is needed to stratify causes for poor control as well as management strategies to reduce the burden of diabetes complications.*

Introduction

Diabetes Mellitus (DM) is one of the most common chronic diseases globally and in Saudi Arabia, and it places a dwelling burden on the community and the healthcare system. As estimated by International Diabetes Federation, 463 million people are living with diabetes worldwide, and the figure is only estimated to raise higher by 2030 to 578 million.[(1)] In Saudi Arabia, the prevalence of type 2 diabetes is estimated to be over 25% of the adult population[(2)], furthermore a local study by Al-Daghri et al. in Riyadh, an urban city with a population of 6.8 million at the time,[(3)] demonstrated even higher prevalence at 31.6%.[(4)] A study conducted to establish the economic burden of diabetes showed that the direct expenditure on diabetes was around $0.9 billion dollars in 2010, and this figure is expected to increase to increase to approximately $6.5 billion dollars by 2020.[(5)]

Diabetes is one of the hardest challenges to the primary care physician, as its control is not only challenged by the necessity of delaying the expected complications, but also by prevention of overcorrection triggering iatrogenic hypoglycemia. Complications of diabetes include retinopathy, nephropathy and impending kidney failure, neuropathy, and diabetic foot and inevitable amputations.

As per the American Diabetes Association (ADA) diabetic patients should be routinely tested to assess the degree of glycemic control. Glycated hemoglobin (HbA1c) is a standard measurement of glucose over 3 months, and targeted level for diabetic patients is to be maintained less than 7%, with a looser cut point for elderlies to avoid iatrogenic hypoglycemia.[6] This measurement gives the patient and their doctor a clear indication of how they are controlling the disease, and aids in tailoring the management further. HbA1c holds a prognostic potential as well, an increase of HbA1c increases all-cause mortality by 30%, and increases the mortality of ischemic heart disease by 40%.[7]

The rate of glycemic control varies globally, with a notable improvement in the US as demonstrated by flan et al, where the mean HbA1c dropped from 7.82% between 1999-2000 to 7.18% in 2004.[8] A local study done in our institution covering the period between 2006-2009 showed poor glycemic control, The mean of the HbA1c was 8.7 on 2006 and reduced to 8.6 within four years[9], another study done 2017 demonstrated inadequate glycemic control at a similar rate (8.5%).[10]

The prevalence of chronic diabetes complications is high. In study by Abu El Asrar AM (1998–1999), found that the prevalence of retinopathy in diabetics is 31% after a mean duration of diabetes mellitus o more than 10 years. Another study was done in the Western part of Saudi Arabia demonstrated that the prevalence of neuropathy is 82%. Moreover, Qidawi et al (2001) reported 29% with diabetic peripheral neuropathy have some features suggestive of diabetic neuroarthropathy, and that 18% of those patients underwent foot amputations.[11]

No recent studies in Saudi Arabia have demonstrated the glycemic control correlated with the complications, and more studies are needed to properly estimate a prevalence of diabetes related complications and their burden.

This study aims to study the average rate of glycemic control in patients with type 2 Diabetes Mellitus in the primary care settings in National Guard Health Affairs Clinics in Riyadh, Saudi Arabia, and the prevalence of its associated complications over 4 years

Methodology

This was a retrospective cohort study for adult type 2 diabetics in a tertiary care hospital and linked primary healthcare clinic (PHC) over 5 years period (from 2016-2020). Data collection sheet was designed by the authors and revised by 2 independent field experts (family physicians). Dataset was extracted from electronic healthcare records and relevant variable was extracted for analysis. Department of Data management provided the dataset of the variables, individual chart review was warranted if variables were in extractable.

The number of type 2 Diabetes mellites patients in the center is estimated to be 44,052, The percentage of type 2 diabetes is estimated to be around 30%[2] based on the populations. Patients included are adult patients with type 2 diabetes (over the age of 18) with exclusion of ladies who were pregnant at any point during the time of the study.

Sample size was calculated at a margin of error of 5% and 1.5 design effect, with a population of 44502 and 16.6% control rate as per the latest study[9] (HgA1C of 7 or less), at 95% confidence interval. Tool used is Open-Epi calculator (access here: https://www.openepi.com/SampleSize/SSPropor.htm). Sample size needed is 318 patients.

Data was analyzed using Statistical Package for the Social Sciences (SPSS- 23), All statistical tests

was conducted at significance level (alpha =0.05). For quantitive variables, mean ± standard deviation (SD) was used. For qualitative variables, we used frequency and percentages. Chi-square test will be used to compare categorical variables (sex, mortality, and diagnoses). Correlation co-efficient will be used for continuous variables (age, systolic blood pressure, and lab variables). T-test and Mann-Whitney U-test will be used to compare means and medians of continuous to categorical variables (age, systolic blood pressure, and lab variables to sex and complications).

Results

Demographics

Over the course of this study, 44502 patients had type 2 diabetes in our hospital and adjunct primary health care clinics, 319 files were then retrieved for file review and data extraction. Females constituted 58.6% of the cases (n=187). The mean age was 61.7 ±12.6 SD, with a wide range between 23 and 101; 62.4% (n=196) were between 50-69 years of age, only 13.8% (n=44) were younger than 50 years old. 90% of the study population were married (n=287), widowed followed at 5.7% (n=18). Only 4.1% were known smokers (n=13), others were either not smokers or their smoking status was unknown at 62.4% and 33.5% (n=199, 177), respectively. No statistical significance was found between HgA1c level and any demographic characteristic. Mean Body Mass Index (BMI) was 31.42± 6.71 SD (range 17.64-70.78), over half of the population (54.7%, n=173) had BMI higher than 30, and 75.6% (n=239) had BMI higher than 27. Majority of the population (83.7%, n=267) had BMI of 25 and higher; no statistical significance was found when correlating HgA1c level with BMI. Demographic characteristics of the population are summarized in Table 1.

Table 1

Demographics of the study population	
Characteristics	No. (%)
Sample size	319 (100)
Sex Male Female	 132 (41.4) 187 (58.6)
Age (years) Mean± SD Range	 61.73 ±12.63 23-101
Marital Status Single Married Divorced Widowed	 6 (1.9) 287 (91.4) 3 (1) 18 (5.7)
Smoking Not smoker Smoker Unknown	 199 (62.4) 13 (4.1) 107 (33.5)
BMI Mean± SD Range	 31.42± 6.71 17.64-70.78

HgA1c

The mean HgA1c for the sample between 2016-2020 was 8.42, 8.63, 8.52, 8.07, and 8.70 mmol/L, respectively (graph 1). There was a significant increase between the years 2019 and 2020 (P-value <.001), but no other statistically significant changes noted. Overall mean for the study period was 8.30 mmol/L± 1.9. 55.1% (n=173) had HgA1c levels higher than 8 mmol/L. Higher HgA1c levels correlated significantly with higher LDL level as a predictor and correlated significantly with complications of retinopathy and neuropathy (p-values of 0.026 and 0.014, respectively).

LDL and HDL

47.6% (n=152) had LDL above the 2.58mmol/L (or 100m/dl), with a mean and SD of 2.72±0.99 (range 0.57-5.96 mmol/L); and of those with history of myocardial infarction only 39.7% (n=11) had an LDL level below 1.8 mmol/L. No statistical significance found between LDL levels lower than 2.58 mmol/L and HgA1c lower than 8 mmol/L (P-value= 0.45); linear regression showed significant correlation between LDL level and HgA1c (p-value = 0.25). 45.5% had HDL level lower than 1, with the mean of 1.04±0.26, No

statistical significance found between HDL and HgA1c levels.

Vitamin B12

Mean and SD for vitamin B12 level were 480.9 pmol/L ±443.4 (range 89-3687); only 4 patients (2.9%) had low vitamin B12 levels, while 24 (17.6%) had levels higher than normal. No significant correlation was found between low B12 level and diabetic neuropathy.

Systolic Blood Pressure

Mean SBP was 134.18 mmHg ±17.8

Range 78-209. 65.3% (n=207) had their SBP below 140 mm Hg. No significant correlation was found between tighter glycemic control and lower SBP (p-value 0.285)

Hospital Admissions

Mean 0.93 ± 2.04

Range 0-14

Mean hospital admission rate was 0.93 days± 2.04SD (range: 0-14). 69.9% (n=223) had 0 admissions and 95.3% (n=304) had less than 5 admissions during the 5 years of the study. No correlation between number of admissions and higher HgA1c values (p-value:0.222), however, number of admissions correlated significantly with mortality (p-value <0.001)

Complications and Mortality

48 patients (29.3%) of those who were screened had evidence of diabetic retinopathy, 155 patients (48.6% of the sample) were not screened during the study period. 23 patients (7.2%) had diabetic neuropathy, 73.9% (n=17) of those had HgA1c level above 8 mmol/L. Neuropathy correlated significantly with higher HgA1c. 29.9% (n=70) had microalbuminuria, and of those 24.4% (n=15) have chronic kidney disease (CKD). Microalbuminuria correlated significantly with Lower Glomerular filtration rate (GFR) (p-value <0.001). 89 patients (27.9%) had no AC ratio done during study period. 7 patients (2.2%) had diabetic foot, and of those 3 (42.9%; 0.9% of overall population) had amputation. Other complications (detailed in Table 3) had no significant correlation with HgA1c levels or mortality. 19 patients expired during the study period. Mortality correlated significantly with lower HgA1c (P-value =0.003).

Table 2

Complications	A1c Correlation P-value	Percentage (number)
Microalbuminuria	0.531	
Myocardial Infraction	0.662	yes 9.1% (29) No 90.9% (290)
Congestive Heart Failure	0.563	yes 9.7% (31) No 90.3% (288)
Retinopathy	0.026*	Yes 15% (48) No 36.4% (116) Not screened 48.6% (155)
Neuropathy	0.014*	Yes 7.2% (23) No 92.8% (296)
Chronic Kidney Disease	0.357	Yes 12.9% (41) No 87.1% (278)
Diabetic foot	0.257	Yes 2.2% (7) No 97.8% (312)
Amputation	0.212	Yes 0.9% (3) No 99.1% (316)
Mortality (negatively)	0.003*	Alive 94% (300) Expired 6% (19)

Discussion

The aim of this retrospective cohort study was determining the rate of glycemic control and associated complications among adults with type II diabetes. We found that among type II DM patients in Saudi Arabia, higher prevalence was observed among females compared to males. Al Salamah et al. reported increased prevalence of type II DM among Saudi females compared to males (12), this study was not designed to assess prevalence, but the slight female majority is going with current literature. In addition, it was found that type II DM patients had high mean BMI score, which might be referred to the metabolic disturbances resulted from DM complications. These results are consistent with the findings reported by Alzaheb & Altemani who reported increased BMI among type II DM in Saudi Arabia [(13)]. The mean BMI for the sample was 31.42 kg/m^2, which places over half of the sample in the obese category. Furthermore, Al Ammar et al. suggested lowering the cut-off for obesity in Saudi Arabian population to 27 kg/m^2 [(14)], which would place over 75% as obese.

The findings of the study showed a suboptimal control of LDL levels. These results are consistent with the findings reported by Hussain et al. who found that there is a significant association between HbA1c levels and high LDL levels among type 2 DM patients in Afghanistan[(15)]. However, these results were not in line with the findings reported by Begum et al. who explored the lipid profile among type 2 diabetic patients in Bangladesh and found that LDL is not significantly associated with HbA1c levels[(16)].

29.9% of the sample had microalbuminuria, the findings are consistent with the local findings reported by Aljabri et al. who found that about one-third of the Saudi type two diabetic patients had microalbuminuria[(17)].

The present study found diabetic retinopathy prevalence at 29.3% with a significant association between high HbA1c levels and retinopathy among Saudi diabetic patients. Those are consistent with the findings reported by Ahmed et al. who found a similar prevalence (36.4%) that uncontrolled HbA1c levels are significantly associated with retinopathy among Saudi type 2 DM patients[(18)].

We found that there is a significant association between HbA1c levels and neuropathy among the study sample, which is consistent with the findings reported by Sendi et al, who reported a significant association between HbA1c levels and neuropathy among Saudi diabetic patients[(19)].

Moreover, it was found that there is a significant weak association between glycemic control and mortality rate among type 2 Saudi diabetic patients, which can be attributed to their frail condition and advance age (around 75% are above 60 years old). The study is following their glycemic control over a limited period of time as well.

This study was limited as it was conducted in a single institute in Riyadh city. It was limited to chart review as well, and therefore obtaining further information about the control was not permissible. No data about admissions to other hospitals. Another limitation is the insufficient data about the onset of diabetes complication which did not allow follow up the onset of diabetes and the onset of complications at a single time line.

Conclusion

Our study found the control of diabetes mellitus in a tertiary care center and primary care clinics to be suboptimal, with a significant association between HbA1c levels and LDL level control, retinopathy, and neuropathy among type 2 diabetic patients in Saudi Arabia. More research is needed to stratify causes for poor control as well as management strategies to reduce the burden of diabetes complications.

Ethical Considerations

Data collected was kept in a secure place; only principal investigator and co-investigators will have access. Data did contain any identification of

the respondent. No consent form needed since our data was collected using chart review.

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