Original Research

The Effect of Triglyceride Concentration on Attainment of Lipid Targets in Patients with Diabetes

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ABSTRACT

Objectives: To evaluate the effects of triglyceride (TG) and glycated hemoglobin (A1C) concentrations in the percentage of patients with diabetes who are within target (WT) for low-density lipoprotein-cholesterol (LDL-C), non-high-density lipoprotein-cholesterol (non-HDL-C) and apolipoprotein B (ApoB), as defined by the Canadian Lipid Guidelines, in a cohort of outpatients presenting at a 350-bed community hospital.
Methods: Laboratory samples from 1919 patients, 18 years or older, who had A1C levels of 6.5% or above were used. Fasting lipid profiles were retrieved, and ApoB was measured.
Results: We found no significant difference in the percentage of those WT for LDL-C as TG increased from normal to intermediate and high levels. For non-HDL-C, we saw a substantial decrease in the percentage of patients WT as TG levels increased from normal (61%) to intermediate (30.4%) and high levels (14.0%). ApoB showed a similar pattern to non-HDL-C: decreasing from normal (68.8%) to intermediate (40.7%) and high levels (21.0%). No significant difference was seen in the percentage of patients WT for the 3 lipid parameters studied with the increase in A1C levels.
Conclusions: As TG increases, we saw discordance in the percentage of patients WT for LDL-C in relation to non-HDL-C and ApoB. Alternative targets to LDL-C should preferentially be used when the TG concentration is elevated.

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RÉSUMÉ

Objectifs : Évaluer les effets des concentrations de triglycérides (TG) et d'hémoglobine glyquée (A1C) dans le pourcentage des patients diabétiques qui sont à l'intérieur des cibles (IC) pour le cholestérol des lipoprotéines de faible densité (cholestérol LDL), le cholestérol non–HDL et l'apolipoprotéine B (ApoB), selon les lignes directrices canadiennes sur les lipides, chez une cohorte de patients en consultation externe qui se présentent dans un hôpital communautaire de 350 lits.
Méthodes : Des échantillons sanguins de 1919 patients de 18 ans et plus qui avaient des concentrations d'A1C de 6,5 % ou plus ont été utilisés. Les profils lipidiques à jeun ont été récupérés et l'ApoB a été mesurée.
Résultats : Nous n'avons observé aucune différence significative dans le pourcentage de ceux IC quant au cholestérol LDL alors que les TG passaient de concentrations normales à des concentrations intermédiaires et élevées. Quant au cholestérol non–HDL, nous avons constaté une diminution substantielle dans le pourcentage de patients IC alors que les concentrations de TG passaient de concentrations normales (61 %) à des concentrations intermédiaires (30,4 %) et élevées (14,0 %). L'ApoB a montré des profils similaires à ceux du cholesterol non–HDL: diminution des patients IC alors que les concentrations de TG passaient de normales (68.8%) à intermédiaire (40.7%) et élevées (21.0%). Aucune différence significative dans les 3 paramètres du bilan lipidique étudiés n'a été observée dans le pourcentage de patients IC lors de l'augmentation des concentrations de l'A1C.

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Conclusions : Alors que les TG augmentent, nous avons constaté une discordance dans le pourcentage de patients IC quant au cholestérol LDL par rapport aux patients IC quant au cholestérol non–HDL et à l'ApoB. Les autres cibles plutôt que le cholestérol LDL devraient être utilisées lorsque la concentration des TG est élevée.

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Introduction

The prevalence of diabetes in Canada is 9.3% and is predicted to increase by more than 44% in the next 10 years (1). Age-adjusted prevalence for diabetes in the United States is estimated to be 12.0% in adults 45 to 65 years of age and 21.5% in adults 65 to 74 (2). Both the 2012 and the recently released 2016 Canadian Lipid Guidelines (3,4) promote the use of low-density lipoprotein-cholesterol (LDL-C) as the central treatment parameter, targeting a value of less than 2.0 mmol/L for most patients with diabetes. Apolipoprotein B (ApoB) (<0.8 g/L) and non-high-density lipoprotein-cholesterol (HDL-C) (<2.6 mmol/L) are considered alternative treatment targets. Hypertriglyceridemia is quite common in patients with diabetes, and the Friedewald equation used to calculate LDL-C is known to underestimate the amount of cholesterol in the LDL particles when the level of triglycerides (TGs) is above the reference range (5). This false lowering of LDL-C can give clinicians unfamiliar with the intricacies of lipoprotein measurements an inaccurate picture of where their patients stand in terms of target attainment. The purpose of the present study was to evaluate the effect of TG and glycated hemoglobin (A1C) concentration on the percentage of people with diabetes who are within target (WT) for LDL-C, non-HDL-C and ApoB in a cohort of outpatients presenting at a 350-bed community hospital. The impact of TG levels on the concordance of the respective target limits for the above 3 lipid parameters was examined in patients with diabetes who had normal, intermediate and high TG levels.

Methods

This study took place between November 5, 2015, and January 29, 2016. Basic demographic data, such as age and sex, were recorded. Using the Laboratory Information System, we identified patients older than 18 years of age who had A1C levels above 6.5%. Plasma samples from the patients for whom fasting lipid profiles had been ordered were retrieved each day, and ApoB levels were measured. Chemistry parameters (total cholesterol, HDL-C, TG and ApoB) were measured on an Abbott Chemistry Analyzer (Architect c 16000; Abbott Laboratories, Lake Bluff, Illinois, United States), and A1C levels were measured on the Variant II from Bio-Rad (Hercules, California, United States). LDL-C was derived from the Friedewald equation (6). The Abbott method of measuring TG levels does not correct for endogenous free glycerol. Patients with type 2 diabetes may have slightly higher free glycerol in circulation, but this increase is unlikely to affect TG-result interpretations (7). The project was approved by the Ethical Committee of Horizon Health Network. Statistical analyses were done using the ANOVA test, followed by the Tukey HSD post hoc test to analyze differences between groups. The chi-square test was used to evaluate whether, for each of the 3 lipid targets, there was a difference in the percentage of patients' WT levels at each TG level and as TG increased. Both the ANOVA and chi-square test were used to see whether, for each of the 3 lipid parameters studied, there was a difference in the percentage of patients' WT levels as A1C increased.

Results

The whole cohort included 1995 patients with diabetes. Seven patients were excluded because they had TG values above 11.3 mmol/L and, as a result, we could not calculate and/or measure LDL-C, non-HDL-C or ApoB. LDL-C levels could not be calculated in 69 additional patients because the TG levels were between 4.5 and 11.3 mmol/L. The average age of participants (not including patients with TG levels 4.5 to 11.3 mmol/L) was 63.6 years (SD 12.0), and 57.5% were male. Average A1C levels for this group were 7.8% (SD 1.26). The 3 lipid targets (LDL-C, non-HDL-C and ApoB) were compared in 1919 patients.

Of the patients, 51.8% had normal TG levels, and 23.4% and 21.1% had TG levels of 1.70 to 2.29 mmol/L and 2.30 to 4.50 mmol/L, respectively; 3.8% of patients had TG levels above 4.50 mmol/L. In the normal TG group (Table 1) no significant difference was found in the percentage of patients WT for the 3 lipid parameters studied. We also noted that the mean of LDL-C was smaller in the normal-TG group in relation to the moderate and high-TG group. No significant difference was seen in LDL-C concentrations between the intermediate and high-TG groups. In contrast, we noted that total cholesterol increased and HDL-C decreased with increasing TG levels. Furthermore, the mean and mean/reference value for non HDL-C and ApoB increased significantly as TG increased. More important, we noted (Figure 1) that as TG levels increased there was a discrepancy in the percentage of patients WT for LDL-C in relation to the percentage of patients WT for non-HDL-C and ApoB. For LDL-C there was no significant difference in the percentage of those WT as TG increased to moderate and high levels. For non-HDL-C, we saw a substantial decrease in the percentage of those WT as TG increased from normal (61%) to moderate (30.4%) and high levels (14.0%). ApoB also showed a significant decrease in the percentage of those WT as TG increased from normal (68.8%) to
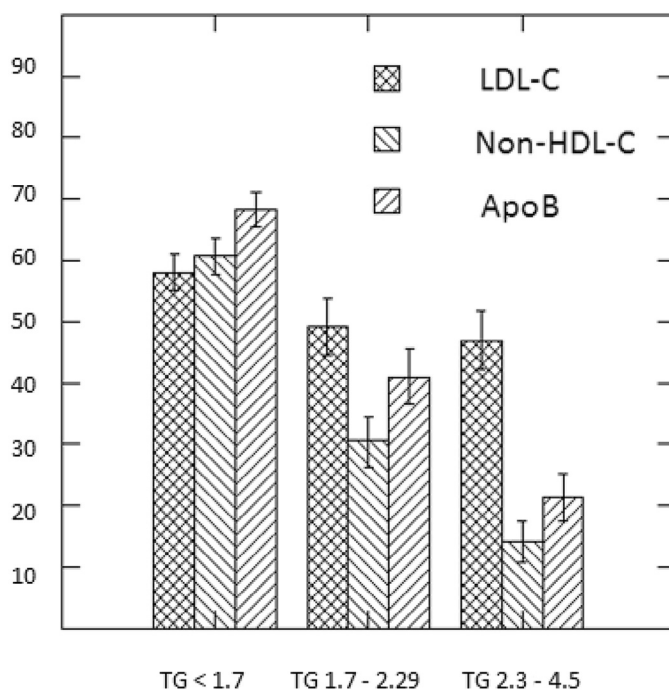
Figure 1. Percentage of patients with diabetes who were on target in relation to triglyceride (TG) levels (mmol/L). LDL-C, low-density lipoprotein-cholesterol; non-HDL-C, non-high-density lipoprotein-cholesterol; ApoB, apolipoprotein B.