

Lipohypertrophy Effect on Glycemic Profile in an Adult With Type 1 Diabetes Using Scanned Continuous Glucose Monitoring

Philippe Oriot, MD¹  and Michel P. Hermans, MD, PhD²

For people with diabetes, managing decisions to minimize hypoglycemia and hyperglycemia is stressful. To improve glycemic control, there is a growing shift toward continuous glucose monitoring (CGM).¹

Additionally, CGM allows the observation of new glucose patterns due to insulin injections in individuals with lipodystrophy of which there are two main types: lipohypertrophy (LH—an enlargement of adipocytes manifesting as swelling or induration of fat tissues) and lipoatrophy (LA—a loss of adipocytes manifesting as indenting and cratering). Lipoatrophy is considered an immune complex-mediated inflammatory lesion that has decreased due to the advent of human insulin.² Lipohypertrophy causes delayed release of insulin and is related to inappropriate insulin injection techniques (needle reuse, inappropriate needle length selection, and insufficient site rotation).³ Often, the development of LH is associated with poorer glycemic control, higher glycemic variability (GV), and unpredictable hypoglycemia.⁴ Lipohypertrophy is often difficult to identify because of variable morphological characteristics, the lack of a well-validated identification methodology, and shortage of practical means to identify patients at risk. Recently, Gupta et al published best practices for LH identification.⁵ According to recent studies, the prevalence of LH could reach 50% to 70% depending on the LH screening techniques used.^{4,5} Therefore, LH may alter the pharmacokinetics of insulin, as clearly illustrated by our case.

A 77-year-old man with life-long type 1 diabetes was seen for unusual hyperglycemia. The insulin therapy consisted of a basal-bolus regimen (glargine 300 U and aspart 100 U) injected via 4 mm needles. His diet and eating habits were normal. On clinical examination, a palpable mass corresponding to a LH area was observed at the main abdominal insulin injecting site.

Analysis of Free Style Libre sensor over a 90-day period prior to consultation showed diurnal hyperglycemia and nocturnal hypoglycemia (Table 1). He was advised to not inject insulin into the LH “lumps area” but rotate the injection sites. The insulin doses were maintained. After one month, HbA_{1c} decreased from 7.9% to 7.2% (63–56 mmol/mol) with a marked reduction

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Table 1. Glucose Profile Pattern Between Period 1 (Insulin Injected in Lipohypertrophy) and Period 2 (Out of Lipohypertrophy).

Characteristics	Period 1	Period 2	Glucose profile characteristics	24 h			(6 h-midnight)		(midnight-6 h)	
				1	2	Δ(2 – 1)	1	2	1	2
Periods analyzed (days)	90	49	Mean glucose level (mg/dL)	182	132	–50	195	135	143	125
Captured sensor data (%)	100	100	SD (mg/dL)	72	52	–20	72	55	57	41
Daily scans	8	9	% >250 (mg/dL)	18	4	–14	23	5	5	1
Hypoglycemic events ^a	30	62	% >180 (mg/dL)	45	15	–30	53	17	23	11
eA _{1c} (%)	7.9	6.3	% 70–180 (mg/dL) TIR	52	77	25	47	74	69	86
HbA _{1c} % (mmol/mol)	7.9 (63.3)	7.2 (56)	% <70 (mg/dL)	3	8	5	2	10	8	3
Aspart U 100 dose per meal	3–14–13 U	3–12–10 U	% <54 (mg/dL)	1	2	1	0	3	3	0
Glargine U 300 dose	18 U	17 U	Mean of GV (SD)/Mean glucose	40	39	–0.2	37	41	40	33

Abbreviations: eA_{1c}, estimated HbA_{1c}; TIR, time in range.

Δ is the difference between period 2 and period 1

^aBy Free Style Libre report.

in postprandial hyperglycemia >180 mg/dL (Table 1). Either side of the consultation, we observed a constant daily mean day–night cycle GV, but altered nocturnal vs diurnal GV (40–33 vs 37–41, respectively) and increased diurnal hypoglycemia (Table 1). After changing the injection site, an increasing time in range glucose level (70–180 mg/dL) of 25% and a worsening of postprandial hypoglycemia was observed, which leads to substantial reduction of fast-acting insulin doses.⁶ The injection

¹Centre Hospitalier de Mouscron, Service de diabétologie et endocrinologie, Mouscron, Belgium

²Cliniques Universitaires Saint-Luc, Service d'endocrinologie et Nutrition, Brussels, Belgium

Corresponding Author:

Philippe Oriot, MD, Mouscron Hospital Centre, 49, Avenue de Fécamp, Mouscron 7700, Belgium.

Email: p.oriot@chmoucron.be

technique guidelines highlight the need to immediately reduce insulin dosages by 20% when moving injection sites as Frid et al recommend.³

This clinical case demonstrates the CGM's usefulness in monitoring insulin-treated patients with diabetes with LH. A change in pharmacokinetic and quantitative biological effects of insulin is likely to be involved in the changes observed, and related to the displacement of injections away from the LH zone, and in the occurrence of hypoglycemia and the need to reduce prandial insulins.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: PO and MPH wrote the manuscript and researched data, contributed to discussion and reviewed/edited the manuscript. PO is the guarantor of this case report and, as such, takes responsibility for the integrity of the data and the accuracy of the data analysis.

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ORCID iD

Philippe Oriot  <https://orcid.org/0000-0002-9810-0303>

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