Diabetes & Metabolism 44 (2018) 61–72

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com

Position Statement

Practical implementation, education and interpretation guidelines for continuous glucose monitoring: A French position statement

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Abbreviations: AGP, Average glucose profile; AJD, Association d'aide aux jeunes diabétiques (Young Diabetics Help Association); CGM, Continuous glucose monitoring; CODEHG, Collège des diabétologues et endocrinologues des hôpitaux généraux (College of General Hospital Diabetologists and Endocrinologists); CNP-EDMM, Conseil national professionnel d'endocrinologie, diabète et maladies métaboliques (National Professional Council of Endocrinology, Diabetes and Metabolic Diseases); CV, Coefficient of variation; EVADIAC, Groupe d'évaluation dans le diabète des implants actifs (Evaluation Group of Active Implants in Diabetes); FFD, Fédération française des diabétiques (French Diabetes Federation); FGM, Flash glucose monitoring; FSL, FreeStyle Libre; IG, Interstitial glucose; IQR, Interquartile range; PLGS, Predictive low-glucose suspend; TLGS, Threshold low-glucose suspend; SFD, Société francophone du diabète (Francophone Society of Diabetes); SFE, Société française d'endocrinologie (French Society of Endocrinology); SMBG, Self-monitoring blood glucose; T1D, Type 1 diabetes; T2D, Type 2 diabetes; TIR, Time in range.

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https://doi.org/10.1016/j.diabet.2017.10.009
1262-3636/

ARTICLE INFO

Article history:
Received 21 July 2017
Received in revised form 16 October 2017
Accepted 17 October 2017
Available online 11 November 2017

Keywords:
Continuous glucose monitoring
Flash glucose monitoring
Guidelines
Patient education
Subcutaneous insulin infusion
Type 1 diabetes
Type 2 diabetes

ABSTRACT

The use by diabetes patients of real-time continuous interstitial glucose monitoring (CGM) or the FreeStyle Libre® (FSL) flash glucose monitoring (FGM) system is becoming widespread and has changed diabetic practice. The working group bringing together a number of French experts has proposed the present practical consensus. Training of professionals and patient education are crucial for the success of CGM. Also, institutional recommendations must pay particular attention to the indications for and reimbursement of CGM devices in populations at risk of hypoglycaemia. The rules of good practice for CGM are the precursors of those that need to be enacted, given the oncoming emergence of artificial pancreas devices. It is necessary to have software combining user-friendliness, multiplatform usage and average glucose profile (AGP) presentation, while integrating glucose and insulin data as well as events. Expression of CGM data must strive for standardization that facilitates patient phenotyping and their follow-up, while integrating indicators of variability. The introduction of CGM involves a transformation of treatment support, rendering it longer and more complex as it also includes specific educational and technical dimensions. This complexity must be taken into account in discussions of organization of diabetes care.

Introduction

The use by diabetes patients of real-time continuous interstitial glucose monitoring (CGM) or the FreeStyle Libre® (FSL) flash glucose monitoring (FGM) system is becoming more and more widespread and has changed patient, caregiver and researcher practices. Recommendations have been published recently for CGM use and data-reporting in clinical trials [1]. The working group bringing together a number of French experts [Conseil national professionnel d'endocrinologie, Diabète et maladies métaboliques (CNP-EDMM; National Professional Council of Endocrinology, Diabetes and Metabolic Diseases), Société francophone du diabète (SFD; Francophone Society of Diabetes), Société française d'endocrinologie (SFE; French Society of Endocrinology), Collège des diabétologues et endocrinologues des hôpitaux généraux (CODEHG; College of General Hospital Diabetologists and Endocrinologists), Groupe d'évaluation dans le diabète des implants actifs (EVADIAC; Evaluation Group of Active Implants in Diabetes), Fédération française des diabétiques (FFD; French Diabetes Federation) and Association d'aide aux jeunes diabétiques (AJD; Young Diabetics Help Association)] has proposed the present consensus to assist professionals in integrating these new technologies into their daily practice. Its main message is that the training of professionals and patient education are crucial to the success of CGM. The main recommendations of the working group are summarized in Table 1.

What is measurement of interstitial glucose?

CGM/FGM devices are based on the semi-continuous measurement of glucose in interstitial tissue. However, there is a discrepancy between the displayed value of interstitial glucose (IG) and that of capillary blood glucose due to the time delay of IG equilibration relative to blood glucose as well as the delay with measurements using subcutaneous electrodes due to converting the electrical signal into glucose levels and displaying the results on a screen [2,3]. Furthermore, the relationship between blood glucose and IG is not just shifted in time, but is a more complex pattern reflecting the dynamic profile of glycaemia, characterized by a glucose lag (difference in glucose values in blood vs. interstitial fluid at each time point) and a time lag (differences in times when IG is equal to blood glucose) [4]. The delay is about 10 min with increased blood glucose, but can be shorter if it is decreased (up to 6 min) [5]. The estimated time for FSL is 4.5 ± 4.8 min [6].

As a result, the observed differences between capillary blood glucose and IG are even greater when glycaemic variations are extreme and rapid. Device trend arrows provide information on the direction and speed of variations in IG levels ($\pm$ 1–2 mg/dL/min for the first level, $\pm$ 2–3 or $>$ 2 mg/dL/min for the second level, and $>$ 3 mg/dL/min for the third level, depending on the CGM system). The trends are generated from the slope of glucose values over the previous 15 min and provide vital information for interpreting the displayed values. The given information must be considered as inseparable value/trend pairs for determining the action to be taken.

The different devices currently available

Table S1 (see supplementary data associated with this article online) summarizes the main characteristics of the different systems that are currently available.

CGM devices

Two types of devices provide real-time CGM:

- independent devices with sensor, transmitter and receiver:
  - Dexcom G4® and G5® (Dexcom, San Diego, CA, USA),
  - FreeStyle Navigator II® (Abbott Laboratories, Chicago, IL, USA),
  - Guardian Connect® (receiver is a smartphone or Apple iPod; Medtronic, Minneapolis, MN, USA);
- devices with sensor and transmitter connected to a subcutaneous insulin pump, which acts as the receiver:
  - Animas® Vibe® (Animas Corporation, West Chester, PA, USA),
  - MiniMed 640G® (Medtronic).

These systems need to be calibrated to capillary blood glucose at least twice a day. The service life of the sensor is 5–7 days. They are capable of producing alarms and some can automatically suspend the basal rate of the pump when either hypoglycaemia arises [threshold low-glucose suspend (TLGS) systems] or before it happens [predictive low-glucose suspend (PLGS) systems]. Some systems can remotely transmit data to a third party in real time (Dexcom G5, Guardian Connect).