Medtronic MiniMed 670G Hybrid Closed-Loop System

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Introduction

New and improved technologies for the treatment of diabetes continue to emerge at an impressive rate. Recent advancements in insulin delivery and continuous glucose monitoring (CGM) have made a particularly meaningful impact on the care and treatment burden of many people living with type 1 diabetes (T1D) (1). One such advancement is the development and approval of the Medtronic MiniMed 670G hybrid closed-loop (670G HCL) system (Medtronic Diabetes, Northridge, Calif.) (2). This brief monograph will highlight key functions of the 670G HCL system and discuss potential advantages and disadvantages of the system.

Indications

The 670G HCL system was initially approved by the U.S. Food and Drug Administration in September 2017 for use in people with T1D who are ≥14 years of age. In June 2018, the indication for the system was expanded to include people with T1D between the ages of 7 and 13 years (2).

How It Works

The 670G HCL system is composed of the MiniMed 670G insulin pump and the Guardian Sensor 3 CGM package (3). The system can function in two different modes: "auto mode" and "manual mode." When in auto mode, the system uses an algorithm capable of automatically adjusting basal insulin delivery in response to CGM readings transmitted to the insulin pump every 5 minutes (4,5). While in manual mode, insulin delivery is not automated and preprogrammed basal rates are infused throughout the day. The system is considered a "hybrid" closed-loop system because it automates basal insulin delivery only. Users must still manually deliver bolus doses to cover meals or correct for residual hyperglycemia. The system requires a minimum of two fingerstick blood glucose calibrations daily, with four or more calibrations per day often needed. While the system is in auto mode, there are two basal blood glucose target options available: 120 and 150 mg/dL. The lower target is the default setting for auto mode, with the higher target an option for use during exercise.

Potential Advantages

The primary advantage of the 670G HCL system is the automated delivery of basal insulin while the system is in auto mode, which may aid users in improving overall glucose control. A study of the system performed in adolescents and adults >14 years of age showed that use of the system resulted in improvements in A1C, increased time within the glucose target range, and less overall hypoglycemia and hyperglycemia compared to baseline (6). Similar benefits were recently reported in a study in children aged 7–13 years, thus supporting the recent approval of the system for use in this age-group (2,7). People with T1D who experience hypoglycemia or glucose fluctuations overnight can particularly find benefit from use of

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the system. Even while it is in manual mode, the system can suspend insulin delivery when the sensor glucose detects a glucose level approaching a threshold for hypoglycemia.

Potential Disadvantages

Although the 670G HCL system provides many potential advantages, it also has several potential limitations and may not be the best treatment option for all people with T1D.

First, the nonmodifiable targets available in auto mode limit options for users. The default 120 mg/dL target may not allow for more intensive control for people who desire (and can safely achieve) it. Likewise, the higher 150 mg/dL target may be insufficient to avoid hypoglycemia during bouts of physical activity.

Second, there are fewer accessible features while the system is in auto mode, such as an inability to use varied bolus settings (e.g., dual-wave or square-wave boluses) or lower basal delivery beyond what is achieved by setting a glucose target of 150 mg/dL.

Third, while the system is in auto mode, users are unable to deliver a manual correction bolus without entering a carbohydrate count into the bolus calculator. Users quickly find a work-around solution for this, however, by entering "phantom" or "fake" carbohydrate amounts into the system to initiate a correction bolus (4).

Finally, although the system's auto mode may ease management burden for some people with T1D, others may feel that use of the system requires more of their time and attention, depending on the individual.

Cost

The out-of-pocket cost of the system to an individual is highly variable depending on insurance coverage and other factors. Insurance companies generally cover a new insulin pump for people with T1D every 4 years, with out-of-pocket costs varying by plan. The full retail price of the system has been reported as ~$8,000 (8), with additional ongoing costs of insulin, insulin infusion sets, and insulin reservoirs.

Commentary

As the first HCL system on the market, the 670G system is an important step toward the realization of a true artificial pancreas for the management of T1D. Studies evaluating the system have reported improvements in time within glucose target range and decreased hypoglycemic events in adolescents and adults with T1D, and more recently in children between the ages of 7 and 13 years. The recent FDA approval for use of the 670G HCL system in children within this age-group is particularly exciting when considering the potential relief of monitoring burden for parents and caregivers that the system may provide. It is important to consider, however, that the current system does not allow for remote monitoring, as do other CGM devices on the market.

As the first HCL system to market, there are inevitable limitations to the 670G system that should be considered. Such potential limitations include the availability of only two nonmodifiable glucose targets and the inability to administer correction doses without entering carbohydrate data. As with any therapy, it is important that users and caregivers have reasonable expectations for the device in terms of treatment outcomes and use requirements.

Bottom Line

There are advantages and disadvantages with any new system, and the 670G HCL system is no exception. Despite its potential limitations, many people with T1D—now inclusive of children between 7 and 13 years of age—may benefit from the advantages the system offers in terms of the potential for less hypoglycemia and more time in the glucose target range.

Duality of Interest

No potential conflicts of interest relevant to this article were reported.

Author Contributions

T.K. and J.J.N. researched data and wrote the manuscript. J.J.N. is the guarantor of this work and, as such, had full access to all references cited and takes responsibility for the accuracy of content.

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