Original Paper

Advanced Hybrid Closed-Loop Insulin Delivery System in Asian Patients With Type 1 Diabetes: Exploratory Study

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Abstract

Background: The MiniMed 780G insulin delivery system has demonstrated improved hemoglobin A_{1c} (HbA_{1c}), time in range, and quality of life (QoL) in clinical trials, but real-world studies are lacking in Southeast Asia.

Objective: Our study aimed to explore the preliminary efficacy and safety of the Medtronic MiniMed 780G advanced hybrid closed-loop system, as well as the impact on QoL, in Southeast Asian adults with type 1 diabetes (T1D) who were previously on either multiple daily injections or conventional pump therapy over 24 weeks.

Methods: A prospective, single-center pilot study was conducted in patients with T1D on multiple daily injections or conventional pump therapy. Primary end points included the change in HbA_{1c} at 12 and 24 weeks. Secondary end points included continuous glucose monitoring glycemic metrics, change in total daily insulin dose, QoL scores, and adverse events.

Results: Nine patients (n=5 male) with a mean age of 35 (SD 10.9) years completed the study. Mean HbA_{1c} improved from 7.3% (SD 0.9%; mean 56.3, SD 9.8 mmol/mol) to 6.9% (SD 0.6%; mean 51.2, SD 6.4 mmol/mol) at 12 weeks and 7.0% (SD 0.6%; mean 53.0, SD 6.1 mmol/mol) at 24 weeks, respectively. All patients achieved the target time in the target range of over 70%, time above the target range of less than 25%, and time below the target range of less than 4% at 12 and 24 weeks. Reduction in total daily dose of insulin was observed for all patients at 24 weeks.

Conclusions: Our study demonstrated the usability, safety, and possible improvement in glycemic outcomes with the MiniMed 780G system in Asian adults with T1D, independent of their baseline insulin therapies.

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Keywords: type 1 diabetes; advanced hybrid closed-loop; time in range; quality of life; insulin pump

Introduction

Optimal glycemic control in type 1 diabetes (T1D) is a well-established strategy to reduce the risk of diabetes complications based on the Diabetes Control and Complications Trial [1]. However, achieving good glycemic control in T1D without significant hypoglycemia continues to pose a challenge. Hemoglobin A_{1c} (HbA_{1c}) does not reflect the acute glycemic excursion and variability and can be affected by conditions that target red blood cell turnover. Continuous glucose monitoring (CGM) metrics for the assessment of glycemic control, such as time in the target range (TIR), time above the target range (TAR), time below the target range (TBR), glucose management indicator (GMI), and glycemic variability, allow for monitoring of glycemic excursion and daily glucose profile and have been standardized for clinical use [2]. TIR has been shown to predict the development of diabetes complications [3,4] and can be used in tandem with HbA_{1c} for monitoring of diabetes control. Recent paradigm shifts in diabetes management with the development of continuous subcutaneous insulin infusion or insulin pump technology as well as CGM have changed the clinical landscape and shown benefits in improving HbA_{1c}, TIR, and quality of life (QoL), and reductions in hypoglycemia [5,6]. The latest advances in insulin pump technology include the automated insulin delivery systems that comprise the insulin

pump, CGM, and an automated insulin dosing algorithm that allows for continuous automated adjustment of the insulin infusion rates. The Medtronic MiniMed 780G is the second automated insulin delivery system developed by Medtronic. It uses an advanced hybrid closed-loop (AHCL) algorithm, and the technology includes automatic basal insulin delivery and an automatic correction bolus delivery every 5 minutes, which can compensate for inaccurate carbohydrate counting or missed boluses [7,8]. The system allows for 3 adjustable targets of 100 mg/dL (5.5 mmol/L), 110 mg/dL (6.1 mmol/L), and 120 mg/dL (6.7 mmol/L) for greater flexibility.

Randomized controlled trials and real-world studies have demonstrated that the AHCL insulin delivery system resulted in improvement in HbA_{1c} and TIR compared to multiple daily injections (MDI) or conventional pump therapy [5,6,9,10].

In addition to glycemic control, QoL is an important outcome measure as it reflects the multidimensional impact of diabetes on the overall physical, psychological, and social well-being of the patients. Studies have demonstrated that use of technology such as continuous subcutaneous insulin infusion can possibly improve the QoL of patients with T1D [10-12]. However, real-world data on the impact of the AHCL system on glycemic outcomes and QoL are still lacking in Southeast Asia. Singapore is one of the first few countries in Asia to approve and have access to this latest AHCL system. This pilot study aimed to evaluate the preliminary efficacy and safety of the Medtronic MiniMed 780G AHCL system, as well as the impact on QoL, in Southeast Asian adults with T1D who were previously on either MDI or conventional pump therapy over 24 weeks.

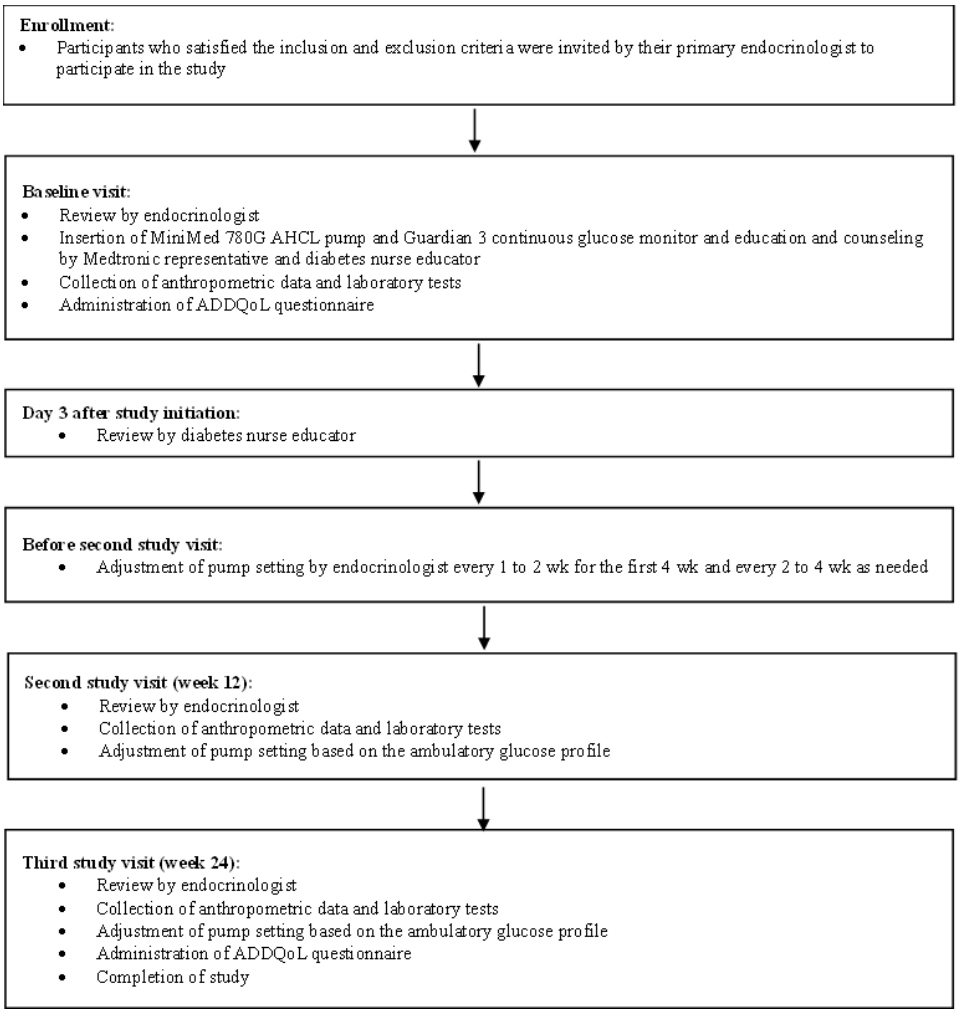
Methods

Study Design

This was a prospective, single-center, single-arm exploratory study conducted at Changi General Hospital with a duration of 24 weeks. At the baseline visit, the MiniMed 780G AHCL pump, Guardian Link 3 transmitter, and Guardian Sensor 3 were inserted. Participants were trained to use the MiniMed 780G AHCL pump, Guardian Link 3 transmitter, Guardian Sensor 3, and the CareLink Connect app by Medtronic representatives and a diabetes nurse educator. Training by Medtronic staff is compulsory real-world standard-of-care practice for initiation of insulin pumps to ensure safe and appropriate device use. Manufacturer-delivered training can introduce a potential source of performance bias and conflict of interest, which is a study limitation. To minimize variability in training delivery, a standardized training protocol was used consistently, and training for all participants was conducted by the same Medtronic staff. Furthermore, the study and safety outcomes were objective and adjudicated end points that are inherently less susceptible to training-related performance bias.

Participants were initiated on manual mode and transited to auto mode after 1 week with the initial setting of a glucose target of 5.5 mmol/L (100 mg/dL) and active insulin time (AIT) of 4 hours. The MiniMed 780G AHCL pump requires a minimum of 48 hours of manual mode before transiting to auto mode. There is no standardized manual mode duration, but 1 week of manual mode will give adequate time for the user to be competent with pump use as well as optimizing the basal and carbohydrate ratio settings before switching to auto mode. These factors will affect the algorithm's insulin dosing decisions in auto mode. Adjustment of the AHCL pump settings was done by the attending endocrinologist every 1 to 2 weeks for the first 4 weeks and every 2 to 4 weeks as needed for the remainder of the study period based on the ambulatory glucose profile. The participants were reviewed by both the attending endocrinologist and the diabetes nurse educator at the baseline visit, 3 days after study initiation, and at 12 and 24 weeks. Figure 1 summarizes the overview of the study workflow and visits.

Figure 1. Overview of the study workflow and study visits following initiation of advanced hybrid closed-loop (AHCL) insulin delivery. The flowchart outlines participant enrollment, baseline assessments and device initiation, interval pump setting adjustments, the second study visit at week 12, and the final study visit at week 24. ADDQoL: Audit of Diabetes Dependent Quality of Life.



Data Collection and Outcome Measures

Anthropometric data such as height, weight, BMI, and blood pressure were collected at each clinic study visit. Laboratory tests (renal panel, HbA_{1c}, lipid panel, glucose, and urine albumin-to-creatinine ratio) were collected at the baseline visit, 12 weeks, and 24 weeks. CGM metrics of glycemic control such as TIR, TAR, TBR, GMI, mean glucose, and glucose variability were extracted from the CareLink clinical software and reviewed at 12 weeks and 24 weeks. Participants were given the Audit of Diabetes Dependent Quality of Life (ADDQoL) questionnaire at the baseline visit and at 24 weeks. Primary end points of the study included the change in HbA_{1c} at 12 and 24 weeks. Secondary end points of the study included CGM metrics, TIR (3.9-10.0 mmol/L), TAR (>10 mmol/L), TBR (<3.9 mmol/L), GMI, glucose variability, change in total daily insulin dose (TDD) at 12 and 24 weeks, change in QoL scores at 24 weeks, and number of adverse events.

QoL Questionnaire

The ADDQoL questionnaire developed by Bradley et al [13] is a disease-specific instrument that measures the impact of diabetes mellitus on QoL. The ADDQoL questionnaire was used in this study as it has been demonstrated to be valid and reliable in the Asian population [14]. It consists of 2 items, with the first assessing the current overall QoL and the second assessing the impact of diabetes on specific aspects of life using 19 domains. The 19 domains ask the participants to rate how their life would be if they did not have diabetes. Each domain consists of 2 components: impact (range from –3 [maximum negative] to +1 [positive]) and importance (range from 0 [least] to 3 [most]). The product of the impact and importance ratings determines the weighted impact score, which may range from –9 to +3 for each domain. The average weighted impact (AWI) score can also be calculated by dividing the sum of the weighted ratings by the total number of domains that are applicable. A lower AWI score indicates a heavier diabetes burden.

Participants and Recruitment

Patients who fulfilled the inclusion and exclusion criteria were referred by their primary endocrinologist for participation in the study. Eligible participants were patients aged 18 years and older with a clinical diagnosis of T1D of at least 1 year of duration and HbA_{1c} of 5% to 10% at enrollment treated with either MDI or conventional pump therapy, ability to perform carbohydrate counting and self-monitoring

of blood glucose, and technical capability to use an insulin pump and CGM and ownership of a mobile device. Patients who were pregnant or breastfeeding, those with severe renal or liver impairment or serious psychiatric illnesses, and those with malignancy with a life expectancy of less than 1 year were excluded. No formal sample size calculation was performed as the study was exploratory in nature. This study aimed to recruit 12 participants as a pragmatic benchmark in accordance with methodological guidance for pilot and feasibility trials [15]. Furthermore, because previous clinical data on the MiniMed 780G system consistently demonstrated substantial improvement in glycemic metrics, an anticipated large clinical effect size was expected.

Feasibility and Acceptability

Feasibility was assessed based on the recruitment and retention rates, completion of study visits, adherence to the MiniMed 780G AHCL insulin pump and Guardian 3 continuous glucose monitor, and completeness of data. Acceptability was assessed based on the patient-reported outcomes using the ADDQoL questionnaire, as well as any reportable adverse events or technical malfunction.

Statistical Analysis

Due to the exploratory nature and small sample size (n=9), data were analyzed using both nonparametric and descriptive statistics. Differences between HbA_{1c}, TDD, and QoL scores at baseline and follow-up visits were evaluated using the Wilcoxon signed-rank test for paired samples. This nonparametric approach was used to analyze within-participant changes without assuming that the paired differences followed a normal distribution. Mean change estimates are reported alongside 95% CIs. Effect sizes were calculated using the Hedges g to quantify the magnitude of changes in glycemic control, insulin requirements, and QoL scores following AHCL initiation, providing complementary information to P values. The mean TIR, TAR, and TBR were also analyzed and compared at 12 weeks and 24 weeks. Analysis of QoL was done by measuring the mean overall QoL scores and the AWI scores at 0 and 24 weeks. All statistical analyses were performed using R (version 4.6.0; R Foundation for Statistical Computing). There were no missing data.

Ethical Considerations

The study and research protocol (reference 2022-2105) were approved by the SingHealth Centralized Institutional Review Board, and the study was conducted in accordance with the principles of scientific ethics and the Declaration of Helsinki. Written informed consent was obtained from all study participants. All data were deidentified before analysis, and confidentiality was maintained throughout the study. Participants were partially subsidized for the MiniMed 780G AHCL insulin pump and its associated consumables.

Results

Baseline Characteristics

Eleven patients were recruited between June 2022 and April 2024. A total of 9 patients completed the study and were included in the analysis. One patient withdrew after 12 weeks due to issues with the Guardian 3 continuous glucose monitor, and 1 patient withdrew due to pregnancy, with a retention rate of 81.8% (9/11). Demographic characteristics and baseline insulin therapies are described in Table 1. Of the enrolled participants, 44.4% (n=4) were female, the mean age of the participants was 35 (SD 10.9) years, the mean duration of diabetes was 16.3 (SD 12.1) years, the mean HbA_{1c} was 7.3% (SD 0.9%), and the mean TDD of insulin was 51.7 (SD 18.5) units. A total of 66.7% (n=6) of the participants were treated with MDI, and 33.3% (n=3) of the participants were treated with conventional pump therapy. Table 2 showed the longitudinal changes in HbA_{1c} and TDD for the individual participants following AHCL initiation.

Table 1. Baseline characteristics of the participants (N=9).

Characteristics	Values
Sex (female), n (%)	4 (44.4)
Age (y), mean (SD)	35 (10.9)
BMI (kg/m^2), mean (SD)	23.6 ± 3.3
HbA_{1c}[a] (%), mean (SD)	7.3 (0.9)
HbA_{1c} (mmol/mol), mean (SD)	56.3 (9.8)
Duration of diabetes (y), mean (SD)	16.3 (12.1)
Insulin total daily dose (units), mean (SD)	51.7 (18.5)
Insulin dose (units/kg/d)	0.71
Therapy used, n (%)	
MDI[b]	6 (66.7)
Conventional pump therapy	3 (33.3)

[a]HbA_{1c}: hemoglobin A_{1c}.
[b]MDI: multiple daily injections.

Table 2. Individual participant characteristics and longitudinal changes in hemoglobin A_{1c} (HbA_{1c}) and total daily insulin dose (TDD) following initiation of advanced hybrid closed-loop insulin delivery (N=9).

Participants	Age (y)	Sex	Therapy	HbA_{1c} at 0 wk (%)	HbA_{1c} at 12 wk (%)	HbA_{1c} at 24 wk (%)	TDD at 0 wk (U/d)	TDD at 12 wk (U/d)	TDD at 24 wk (U/d)
1	50	Male	Conventional pump	6.6	6.8	7.0	40	41.7	38.1
2	38	Male	MDI[a]	7.0	6.2	6.1	40	34.2	36.5
3	29	Male	MDI	6.6	6.5	6.6	38	41.3	37.1
4	24	Male	MDI	7.5	7.0	7.1	56	39.6	40.3
5	20	Male	MDI	6.0	6.6	7.5	39	31.5	33.3
6	52	Female	MDI	9.1	7.8	7.7	40	32.6	35.3
7	33	Female	MDI	7.3	6.4	6.5	75	74.8	69.4
8	39	Female	Conventional pump	7.9	7.8	7.7	48	44.1	44.6
9	30	Female	Conventional pump	7.4	7.3	6.8	89	57.7	57.7

[a]MDI: multiple daily injections.

Glycemic Outcomes

The mean HbA_{1c} reduction was –0.33% (95% CI –0.79% to 0.12%) at 12 weeks and –0.27% (95% CI –0.92% to 0.38%) at 24 weeks (Table 3). Although the reduction in HbA_{1c} was not statistically significant at 12 weeks (P=.16) and 24 weeks (P=.29), the moderate effect size at 12 weeks (g=–0.50) indicates a trend toward improved glycemic control. The mean TDD decreased from 51.67 (SD 18.46) units to 44.17 (SD 13.92) units and 43.59 (SD 12.12) units at 12 weeks (P=.04) and 24 weeks (P=.004), respectively, and the reduction was statistically significant with a large effect size (Table 3). The mean TAR was 18.4% (SD 4.6%) and 19.4% (SD 3.5%), the mean TIR was 79.9% (SD 3.8%) and 78.8% (SD 2.8%), and the mean TBR was 1.7% (SD 1.2%) and 1.8% (SD 1.1%) at 12 weeks and 24 weeks, respectively (Table 4). All participants achieved the ambulatory glucose profile glycemic target of TIR above 70%, TAR below 25%, and TBR below 4% at both 12 and 24 weeks.

Table 3. Paired changes in hemoglobin A_{1c} (HbA_{1c}) and total daily insulin dose following initiation of advanced hybrid closed-loop insulin delivery[a].

Outcome parameter	0 wk, mean (SD)	12 wk, mean (SD)	24 wk, mean (SD)	Change at 12 wk, mean (SD; 95% CI)	12-wk effect size, Hedges g	P value (12 wk)	Change at 24 wk, mean (SD; 95% CI)	24-wk effect size, Hedges g	P value (24 wk)
HbA_{1c} (%)	7.27 (0.89)	6.93 (0.59)	7.00 (0.56)	–0.33 (0.59; –0.79 to 0.12)	–0.50	.16	–0.27 (0.85; –0.92 to 0.38)	–0.28	.29
Total daily insulin dose (U/d)	51.67 (18.46)	44.17 (13.92)	43.59 (12.12)	–7.50 (10.70; –15.73 to 0.73)	–0.63	.04	–8.08 (9.70; –15.54 to –0.62)	–0.75	.004

[a]P values were determined using paired statistical testing comparing baseline (0 weeks) to 12 and 24 weeks.

Table 4. Glycemic outcomes and insulin requirements at baseline (0 weeks), 12 weeks, and 24 weeks following initiation of advanced hybrid close-loop insulin delivery. Insulin requirements include total daily insulin dose, total bolus insulin, and total basal insulin.

	0 wk, mean (SD)	12 wk, mean (SD)	24 wk, mean (SD)
HbA_{1c}[a] (%)	7.3 (0.9)	6.9 (0.6)	7.0 (0.6)
HbA_{1c} (mmol/mol)	56.3 (9.8)	51.2 (6.4)	53.0 (6.1)
Total daily dose (units)	51.7 (18.5)	44.2 (13.9)	43.6 (12.1)
Total bolus insulin (units)	30.8 (11.4)	27.3 (6.4)	27.7 (6.3)
Total basal insulin (units)	20.9 (8.3)	16.8 (8.4)	15.9 (6.1)
TAR[b] (>10 mmol/L; %)	—[c]	18.4 (4.6)	19.4 (3.5)
TIR[d] (3.9-10 mmol/L; %)	—	79.9 (3.8)	78.8 (2.8)
TBR[e] (<3.9 mmol/L; %)	—	1.7 (1.2)	1.8 (1.1)

[a]HbA_{1c}: hemoglobin A_{1c}.
[b]TAR: time above the target range.
[c]Not applicable.
[d]TIR: time in the target range.
[e]TBR: time below the target range.

QoL Scores

Table 5 shows the paired changes in QoL scores for the individual participants following AHCL initiation. The mean overall QoL score and perceived QoL score if the patients did not have diabetes increased by 0.67 (95% CI 0.00-1.33) and 0.33 (95% CI –0.53 to 1.19), respectively, after 6 months of AHCL initiation (Table 6). The AWI score ranged from –9 to +3, and lower scores represent greater impact on the 19 specific life domains. The AWI score was lower (–1.21 vs –1.77; mean change –0.56, 95% CI –2.60 to 1.48) after the initiation of AHCL, suggesting greater perceived burden of diabetes on daily life (Table 6). Although the changes in the QoL scores were not significant, the moderate to large effect size (Hedges g=0.68) for the improvement in mean overall QoL score indicates a potential positive impact on overall life satisfaction.

Table 5. Individual participant trajectories and paired changes for quality of life (QoL) scores following initiation of advanced hybrid closed-loop insulin delivery.

Participants	Mean overall QoL score (-3 to +3)		Overall QoL score if the participant did not have diabetes (-3 to +1)		Average weight impact score (-9 to +3)	
	0 wk	24 wk	0 wk	24 wk	0 wk	24 wk
1	1	1	–2	–2	–3.11	0.42
2	2	2	–3	0	–0.16	–0.74
3	2	2	–1	–1	–0.65	–0.84
4	1	2	0	–1	0.00	–2.83
5	1	1	–3	–3	–2.26	–4.21
6	0	1	–3	–3	0.42	–5.16
7	0	2	–3	–3	–5.00	–3.32
8	3	3	–3	–3	1.78	2.00
9	–1	1	–3	–2	–1.89	–1.21

Table 6. Paired changes in quality of life (QoL) scores following initiation of advanced hybrid closed-loop insulin delivery[a].

Outcome parameter	0 wk, mean (SD)	24 wk, mean (SD)	Change at 24 wk, mean (SD; 95% CI)	24-wk effect size, Hedges g	P value
Mean overall QoL score (-3 to +3)	1.00 (1.22)	1.67 (0.71)	0.67 (0.87; 0.00 to 1.33)	0.68	.13
Overall QoL if the participants did not have diabetes (-3 to +1)	–2.33 (1.12)	–2.00 (1.12)	0.33 (1.12; –0.53 to 1.19)	0.27	.75
Average weighted impact score on the 19 specific domains (–9 to +3)	–1.21 (2.06)	–1.77 (2.30)	–0.56 (2.65; –2.60 to 1.48)	–0.19	.73

[a]P values were determined using paired statistical testing comparing baseline (0 weeks) to 24 weeks.

Safety

There were no reported cases of severe adverse events such as hypoglycemia, diabetic ketoacidosis, pump malfunction, or technical issues. One patient reported sensor-related skin irritation, which improved with topical cream.

Discussion

Principal Findings

The advent of diabetes technology and development of AHCL systems have transformed the management of T1D. Automated insulin delivery is increasingly becoming the standard of care for patients with T1D and is recommended as the preferred method of insulin delivery to improve glycemic outcomes [16]. The use of diabetes technology is lower in Asian countries such as Singapore due to access issues, cost, and lack of reimbursement. As such, real-world data on the impact of AHCL insulin delivery technology on glycemic outcomes and QoL is lacking in this region. Our pilot study found that mean HbA_{1c} levels improved from 7.3% (SD 0.9%; 56.3, SD 9.8 mmol/mol) to 6.9% (SD 0.6%; 51.2, SD 6.4 mmol/mol) after 12 weeks of AHCL use, and the improvement persisted at 24 weeks with a mean HbA_{1c} of 7.0% (SD 0.6%; 53.0, SD 6.1 mmol/mol), although it was not statistically significant. Given the small sample size of 9 participants, this study had limited statistical power to detect changes in HbA_{1c}. Therefore, the nonsignificant P values should not be interpreted as evidence that AHCL therapy has no treatment effect. Our participants also achieved a mean TIR of 79.9% (SD 3.8%), TAR of 18.4% (SD 4.6%), and TBR of 1.7% (SD 1.2%) at 12 weeks and a mean TIR of 78.8% (SD 2.8%), TAR of 19.4% (SD 3.5%), and TBR of 1.8% (SD 1.1%) at 24 weeks, meeting the glycemic targets established by the American Diabetes Association guideline and international consensus [2]. The TIR achieved in our study is similar to those reported in other studies. We also demonstrated that the AHCL system resulted in improvement in glycemic outcomes irrespective of the baseline insulin therapy [17]. Beato-Vibora et al [18] evaluated 52 adolescents and adults with T1D transiting from a sensor-augmented pump with predictive low-glucose suspend (SAP-PLGS) to

an AHCL system who achieved a TIR of 79.6%. Petrovski et al [19] recruited 34 children and adolescents with T1D on MDI therapy, achieving a TIR of 78.8% after initiation of the AHCL system. Elbarbary and Ismail [20] assessed 107 patients aged 3 to 71 years with T1D on either MDI therapy or SAP-PLGS, and they achieved a TIR of 81.5%. In the 3 studies, the AHCL system was configured at the optimal setting of a glucose target of 5.5 mmol/L (100 mg/dL) and AIT of 2 hours for adolescents and adults. The use of optimal settings has been associated with better glycemic outcomes with higher TIR without an increase in TBR [21]. Our study was designed before the recommendation of an AIT of 2 hours was established; as such, the optimal setting was established at a glucose target of 5.5 mmol/L (100 mg/dL) and AIT of 4 hours when the patients transited from manual to auto mode to reduce the risk of hypoglycemia. Asians generally have a lower BMI and higher insulin sensitivity and, thus, require a lower TDD per body weight than non-Asians [22]. The primary endocrinologist can adjust the pump setting subsequently according to the glycemic profile as needed. Even without optimizing the settings, our patients achieved a TIR similar to that achieved in studies that use optimal settings and higher than the TIR achieved in a study without optimization of glucose target and AIT [9]. This suggests that the application and response in Asians might be different due to the differences in insulin sensitivity, lifestyle, and meal patterns; as such, individualization is essential for optimizing the AHCL system performance. Further studies with the proposed optimal settings of a glucose target of 5.5 mmol/L (100 mg/dL) and AIT of 2 hours at initiation of auto mode in the Asian population are needed.

Interestingly, TDD decreased in our study, as opposed to the increase in TDD reported in other studies [18-20,23], while one study reported no change in TDD [17,24]. The increase in TDD in these studies was driven by the increase in auto-correction boluses ranging from 18.5% to 36% of the TDD, which contributed to the improvement in glycemic outcomes. In our study, both the total bolus and total basal insulin doses were reduced (Table 4), which might be attributed to the more precise and effective insulin delivery compared to previous self-titration, which is less accurate. Achieving the glycemic targets with the lowest possible TDD can reduce cardiovascular complications and weight gain [25].

T1D has been associated with decreased QoL as well as diabetes distress. In addition to the glycemic outcomes, physicians should also focus on QoL and patients' satisfaction as it has been associated with patients' compliance with medications and overall clinical outcomes [26]. There is recent evidence suggesting improvement in QoL with the use of an AHCL system, especially in children and adolescents [10,27]. Wheeler et al [28] also demonstrated that the use of an AHCL system compared to a SAP-PLGS system can potentially increase treatment satisfaction and quality of sleep. In addition to the limited data on glycemic outcomes, studies on QoL in Asians have been sparse. Interestingly, our study found that while the mean overall QoL score showed a nonsignificant improvement, the AWI score across specific life domains showed a slight nonsignificant decrease after the initiation of the AHCL system. These findings suggest that improvements in overall well-being may not necessarily translate into a reduced perceived impact of diabetes on daily life. AHCL therapy may optimize glycemic management and contribute to overall well-being; however, the ongoing demands of diabetes management and device use may increase the perceived burden of diabetes. Overall, these findings highlight the persistent impact of T1D on QoL and suggest that AHCL therapy may have the potential to improve overall well-being. However, further and larger studies will be needed to evaluate the impact of the AHCL system on QoL and patient satisfaction.

Strengths and Weaknesses

Our study adds to the current paucity of evidence regarding the real-world impact of the MiniMed 780G system on glycemic outcomes and QoL in the Southeast Asian population, highlighting the differences in device adoption between Asians and non-Asians. Other strengths of this study include the prospective nature in a wide age range of adult patients (aged 20 to 50 years), and we included patients on both MDI and basic pump therapy. This study has several limitations, such as a small sample size and the lack of a control group, limiting the ability to infer causal relationships. There was also a lack of baseline CGM data as not all the participants used CGM prior to the initiation of the study; as such, we were unable to evaluate the changes in glycemic metrics such as TAR, TIR, and TBR with the use of the MiniMed 780G system compared to the participants' baseline insulin therapies.

Conclusions

In conclusion, our pilot study provides preliminary and novel evidence supporting the usability, safety, and consistency of the MiniMed 780G system and the potential in improving glycemic outcomes in adults with T1D in a Southeast Asian population independent of their baseline insulin therapies. Individualization is essential for optimizing AHCL system performance, which allows for adaptation to different physiological needs and lifestyles. Larger prospective studies with control groups as well as studies focusing on QoL are needed to confirm these outcomes and support broader adoption and provide a deeper insight on the social and psychological impact of AHCL systems.

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Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' Contributions

Conceptualization: WZ, JK, ADONM
Investigation: WZ, JK, ADONM
Methodology: WZ, JK, ADONM
Project administration: ADONM
Writing—original draft: WL
Writing—review and editing: JK, ADONM
All authors reviewed the manuscript.

Conflicts of Interest

None declared.

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Abbreviations

ADDQoL: Audit of Diabetes Dependent Quality of Life
AHCL: advanced hybrid closed-loop
AIT: active insulin time
AWI: average weighted impact
CGM: continuous glucose monitoring

GMI: glucose management indicator
HbA_{1c}: hemoglobin A_{1c}
MDI: multiple daily injections
QoL: quality of life
SAP-PLGS: sensor-augmented pump with predictive low-glucose suspend
T1D: type 1 diabetes
TAR: time above the target range
TBR: time below the target range
TDD: total daily insulin dose
TIR: time in the target range

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