Original Article

Management of type 1 diabetes mellitus during the COVID-19 pandemic

J. Muthukrishnan [a,*], Nirmala Venugopal [b], A.P. Basavaraj [b],
Garvit Bagga [b], V.Y. Jayakrishnan [c], Khushboo Bharadwaj [d],
Santosh V. Thoke [e]

[a] Consultant (Medicine) & Endocrinologist, Base Hospital, Delhi Cantt, India
[b] Classified Specialist (Medicine), Base Hospital, Delhi Cantt, India
[c] Graded Specialist (Paediatrics), INHS Patanjali, Karwar, Karnataka, India
[d] Classified Specialist (Medicine), Military Hospital Jaipur, Rajasthan, India
[e] Classified Specialist (Medicine), Command Hospital (Southern Command), Pune, India

ARTICLE INFO

ABSTRACT

Background: Patients with type 1 diabetes mellitus (DM) require intensive monitoring, which was adversely affected during coronavirus disease 2019 (COVID-19) restrictions.

Methods: We evaluated the management of type 1 DM and the role of telephonic consultation and follow-up in 46 patients (10 on insulin pump) with type 1 DM at our centre from 1 February 2020 to 31 January 2021. Patients were telephonically counselled fortnightly. Web-based diabetes education sessions for the patients and parents were conducted. Finally, change in HbA1c during the period of the study, frequency of severe hypoglycaemia, hospital admissions for hyperglycaemic emergencies and degree of satisfaction with care rendered by the treating team were assessed by ratings scored by the patients.

Results: Five episodes of severe hypoglycaemia were noted in three patients. Two patients had diabetic ketoacidosis. Patients on insulin pump showed a mean baseline HbA1c of 7.8%. Nine of these patients (90%) showed an improvement in Hba1c during the study period compared to 64.3% of patients on conventional regimen. There were no episodes of severe hypoglycaemia or hospitalization with DKA noted in these patients. Only two patients had COVID-19 disease with mild manifestations. Overall satisfaction levels with therapy were high.

Conclusion: This study illustrates the role played by teleconsultation and video conferencing during the period of the COVID-19 pandemic in ensuring optimal healthcare delivery to patients with type 1 DM. Some of these methods can be used even after the pandemic to improve patient convenience and reduce the out-patient burden on the hospitals.

© 2021 Director General, Armed Forces Medical Services. Published by Elsevier, a division of RELX India Pvt. Ltd. All rights reserved.

Introduction

When the coronavirus disease 2019 (COVID-19) pandemic struck in the initial months of 2020, the healthcare infrastructure was pressed into devoting its maximum resources into its management. Ensuing lockdown starting 24 March 2020 and its restrictions added to the patients not being able to commute to their hospitals. This led to inordinate delays and drug default in the management of patients with chronic medical conditions, especially the non-communicable lifestyle disorders.

Diabetic patients have an increased risk of infection compared with the general population and the risk is even greater in those with type 1 diabetes mellitus (DM) than in type 2 DM.[1] This increased risk of infection is due to hyperglycaemia-induced immune dysfunction (damage to the neutrophil function, depression of the antioxidant system and humoral immunity), micro- and macro-angiopathies, and greater requirement of medical interventions in these patients.[2]

Glycaemic control in patients with type 1 DM requires regular self-monitoring of blood glucose and close supervision by the treating clinician for insulin dose titration, diet and lifestyle modification, screening for complications and associated autoimmune conditions.

Lack of proper follow-up due to the restrictions was expected to impact the management of these patients adversely and hence the need to audit the performance of the treatment of these patients during the period impacted by COVID-19. The aim of this study was to assess the impact of restrictions imposed due to COVID-19 outbreak and telephonic follow-up on the management outcomes of patients with type 1 DM.

Materials and methods

All the patients with type 1 DM, who were registered for follow-up at our centre as of 1 February 2020 were included. Their baseline data were recorded at inclusion based on their records in February–March 2020. All these patients were on individual communication through WhatsApp with the physician, and also a group was formed for any information to be passed on collectively to them. Patients were called individually on their phone numbers registered with the endocrinology department in the hospital, by the nursing staff and advised to follow self-monitoring of blood glucose on a regular basis as per an individualized protocol. The doctor in charge explained the concept of correction dosage of premeal rapid-acting insulin, as per their personalized targets were explained. Patients were explained about the management of hypoglycaemia (<70 mg/dl) and hyperglycaemia (>250 mg/dl). These patients were advised to contact the physician every 2–3 days for dosage adjustment if required.

The patients on insulin pump were advised frequent glucose monitoring based on which dose titration of basal insulin rates and bolus doses was advised telephonically every 2–3 days.

Patients defaulting on regular monitoring and reporting were contacted on phone and reminded on a fortnightly basis by the nursing staff. Diet, regular exercises, glucose monitoring, insulin dose titration and sick day rules were explained as a reminder once every month. Precautions pertaining to COVID-19 were reinforced during these calls. The doctor and the nursing staff were available round-the-clock on-call to offer telephonic consultation and advice regarding glycaemic management and clarify any doubts. During the tele-follow-up calls, those with uncontrolled hyperglycaemia and clinical suspicion of diabetic ketoacidosis were asked to report to the nearest hospital for confirmation and in-hospital management. Those patients having severe hypoglycaemia (requiring another person's support to recover) were explained to seek consultation for insulin dose titration and advice regarding meals. Their primary care physicians have explained regarding the management of any emergency and physical follow-up when required.

A web-based meeting and counselling session for the patients and their parents was held twice by the physician, once in the month of June and later in September 2020.

As the insulin, glucose monitoring strips and insulin pump accessories are provided by the institution free of cost, patients who were unable to attend the hospital clinic were sent these replenishments home, or provided through their local health care facility wherever possible. Patients were asked to get their HbA1c done every 3 months; however, most patients defaulted due to apprehensions about going to a laboratory and paucity of home collection facility during the COVID-19 surge and lockdown. HbA1c was repeated in December 2020/ January 2021, in all the patients who were at the end of the observation period.

At the end of the observation period, on 31 January 2021, we reviewed all the patients and distributed a questionnaire to collect data on frequency of teleconsultation/hospital visits, Hba1c, insulin doses, problems faced during the observation period and level of satisfaction with the treatment services offered. Change in HbA1c during the period of the study, frequency of severe hypoglycaemia, hospital admissions for hyperglycaemic emergencies (DKA) and degree of satisfaction with care rendered by the treating specialist and staff were assessed by ratings out of 10 scored by the patients or their parents (those less than 12 years of age).

Results

A total of 46 patients with type 1 DM were on follow-up at our centre, of which 10 were on continuous subcutaneous insulin infusion through insulin pump and the remaining 36 on conventional multiple-dose subcutaneous insulin (long-acting basal with premeal rapid-acting insulin) injections (MSII). During their initial visit, their telephonic contact details and addresses were obtained from the departmental database. Their baseline data are tabulated in Table 1. Patients on insulin pump had a significantly longer duration of DM, likely

Table 1 – Baseline data of patients with type 1 DM on follow-up.			
	All patients (N = 46)	Patients on insulin pump (n = 10)	Patients on MSII (n = 36)	P value
Mean age (years)	19.1 (6.8)	21.2 (8.5)	18.5 (6.2)	0.27
Mean duration of DM (years)	4.88 (2.46)	7.5 (4.2)	4.41 (2.3)	0.003*
Mean HbA1c (%)	8.2 (1.1)	7.8 (1.2)	8.4 (1.5)	0.44

Table 2 – Follow-up data of patients with type 1 DM on follow-up at the end of the study period.			
	All patients (N = 46)	Patients on insulin pump (n = 10)	Patients on MSII (n = 36)	
Average frequency of teleconsult/physical visit (per month)	4.43 (1.2)	7.8 (2.3)	3.5 (1.4)	0.001*
Episodes of severe hypoglycaemia (n)	05	01	04	
Hospitalization with DKA	02	Nil	02	
Percentage of patients with improvement in HbA1c during the study period	62.5	90	64.3	0.14
Average satisfaction rating amongst patients (out of 10)	9.56 (0.17)	9.8 (0.16)	9.5 (0.12)	0.001*

because they were only put on insulin pump after a few years of observation on MSII.

Percentage of patients with improved HbA1c at the end of the study period, frequency of telephonic contact/physical consultation in the hospital, frequency of severe hypoglycaemia and hospitalization with hyperglycaemic emergency (DKA) are tabulated in Table 2.

The frequency of visits/telephonic contact was significantly higher in patients on insulin pump compared to those on MSII as they needed more frequent monitoring and insulin dose titration.

A total of five episodes of severe hypoglycaemia was noted in three patients. The frequency of consultation was more than once per week in all these patients. The average baseline HbA1c in these patients was 8.4% and it changed to 7.2% by the end of the study.

Two patients were hospitalized for DKA during the study period. Both these patients were on MSII. The frequency of consultation in these patients was less than once per month in these patients before hospitalization. Baseline HbA1c was 9.8% and 11.1% in these patients, which improved to 8.2% and 8.4% by the end of the study.

Two patients were hospitalized for COVID-19 in this period. Both had mild COVID-19, which recovered uneventfully in 10–14 days. Insulin requirement during this period increased in both; however, there was no significant worsening of glycaemic control.

Subgroup analysis of 10 patients on an insulin pump was done, which showed a mean baseline HbA1c of 7.8%. Nine of these patients (90%) showed an improvement in Hba1c during the study period compared to 64.3% of patients on conventional MSII regimen. There were no episodes of severe hypoglycaemia or hospitalization with DKA noted in these patients. They were compared with the patients on conventional MSII regimen for their baseline and post-follow-up data. Glycaemic control (HbA1c) was similar in both groups.

One patient who had been put on an insulin pump in November 2019 on being diagnosed to have a pregnancy with poor glycaemic control (HbA1c 8.4%) was closely followed up through the study period. Her HbA1c levels remained within the target 6.5% without any severe hypoglycaemia and she delivered successfully in July 2020. Inability to report to the hospital for frequent follow-ups because of lockdown

restrictions was circumvented by regular contact through telephone and helped achieve optimal glycaemic control.

Discussion

The COVID-19 pandemic has posed many healthcare challenges and the management of chronic diseases like DM has been one of these. Patients with type 1 DM, because of the nature of their disease, require closer monitoring, frequent follow-up and greater attention to insulin dose modification to ensure optimal outcomes.

The COVID-19 pandemic has raised the need for healthcare delivery through remote mechanisms, and telemedicine has become an effective way with improvement in the availability of Internet, mobile telephone services and availability of smartphones with most of the patients and their caregivers. The use of video conferencing and other such applications for school and college classes during the same period also ensured that parents and children were conversant with it and this helped make it a convenient platform to use.

Having the contact details of these patients in the hospital records and most of them being in regular contact with the physician through WhatsApp (WhatsApp Inc. Mountain View, California, USA) and other mobile applications, helped extend these services during the lockdown. It was reassuring to the patients and their kin, safe due to the risk of virus transmission being mitigated and ensured regular reinforcement of counselling. This ensured high satisfaction levels in the patients and their kin with the service provided by the hospital. It also avoided the cost and time spent in travel and waiting in hospital OPDs, thereby ensuring more time for online school classes and work.[3,4]

Owing to the high risk of COVID-19 infection and greater severity of disease in case of contracting the infection in patients with type 1 DM, there was a sense of panic and concern

amongst these patients and their kin. This resulted in them avoiding visits to their doctors. In those who were not in regular contact with their doctors virtually were not able to contact them or seek online consultation during the pandemic. This often led to default in follow-up and worsening of glycaemic control. Although those on SC insulin injections could procure their insulin from local pharmacies, those on insulin pump would find it difficult to get the accessories, forcing them to delay the replacement or switch to SC injections.

At our centre, we maintained a record of all the type 1 diabetic patients, which helped us to continue the follow-up and address these concerns to a large extent. As an audit of regular teleconsultation, video conferencing for counselling in addition to the management of those who could come for physical hospital visits, we retrospectively assessed the patients for change in HbA1c during the study period, frequency of severe hypoglycaemia, hospital admissions for hyperglycaemic emergencies (DKA) and degree of satisfaction with care rendered by the treating specialist and staff.

Factors that were likely to worsen the metabolic control in these patients were restriction on outdoor movements, psychological stress due to the pandemic, lack of physical interaction with friends and relatives and prolonged sitting due to work.[5,6] In addition, problems in the availability of insulin and glucose monitoring test strips because of logistic reasons during the lockdown were also a concern. These issues were addressed by counselling regarding home-based exercises, yoga, modification in diet, regular sleep and other stress management techniques. We also ensured that each patient was available to get the necessary insulin and other accessories required for proper DM management through our resources and delivery systems.

On the contrary, some benefits noted were timely meals at home, less availability of junk food, greater parental control, less work-related stress and adequate sleep, which were likely to help improve the glycaemic control. In those who were able to continue their daily routine and perform exercise within their premises, noticed either no deterioration in glycaemic control or even improvement in some cases.[7–9] Although the frequency of contact with their healthcare providers was affected, patients' fear of DM being a risk factor for COVID-19 outcomes could have led to improved compliance with doctors' advice leading to better glycaemic control.

Worse glycaemic control leading to a risk of DKA is a possibility with any coincidental infection, it has also been increasingly reported with COVID-19. We noted a change in insulin dosage required to maintain adequate glycaemic control.

In a subset of these patients, who were on insulin pumps, there was a need for more intensive monitoring and adjustment of basal insulin rates and bolus doses, which could be better achieved seamlessly through regular online contact. Where possible, glucose monitoring systems like FreeStyle Libre Pro (Abbot Diabetes Care, Harbour Bay Parkway, Alameda, CA 94502, USA) were used and its data transmitted through WhatsApp to the physician for dosage adjustment and better glycaemic control.

In patients who were regular with their glucose monitoring and contact with the physician had better reduction in Hba1c during the lockdown. These patients also had higher satisfaction levels with the treatment offered.

This study illustrates the role played by telemedicine consultation, video conferencing and regular contact with the healthcare provider through mobile telephonic applications like WhatsApp during the period of COVID-19 pandemic in ensuring optimal healthcare delivery to the patients with type 1 DM. As the physician in charge of the team was following this practice of regular tele-reviews and counselling even before the onset of COVID-19, it only made it handy and effective during this pandemic. If the nursing staff is well trained and motivated to contribute by helping in counselling the patients, and maintaining regular communication, this can be managed well even with the increase in workload after normalcy returns. The physicians at zonal and subzonal hospitals can be educated on a regular basis to help manage such patients at their place of stay. This will not only reduce the stress on hospital logistics but also spare more time for other essential academic and work-related activities while simultaneously improving the patient compliance, convenience and level of satisfaction with the healthcare provided.

Disclosure of competing interest

The authors have none to declare.

Acknowledgements

REFERENCES

1. Carey IM, Critchley JA, DeWilde S, Harris T, Hosking FJ, Derek G. Risk of infection in type 1 and type 2 diabetes compared with the general population: a matched cohort study. *Cook Diabetes Care Mar*. 2018;41(3):513–521.
2. Casqueiro J, Casqueiro J, Alves C. Infections in patients with diabetes mellitus: a review of pathogenesis. *Indian J Endocrinol Metab*. 2012;16(suppl 1):S27–S36.
3. Espinoza J, Shah P, Raymond J. Integrating continuous glucose monitor data directly into the electronic health record: proof of concept [published online ahead of print, 2020 Jan 6]. *Diabetes Technol Therapeut*. 2020.
4. Garg SK, Rodbard D, Hirsch IB, Forlenza GP. Managing newonset type 1 diabetes during the COVID-19 pandemic: challenges and opportunities [published online ahead of print, 2020 Apr 17]. *Diabetes Technol Therapeut*. 2020.
5. Brazendale K, Beets MW, Weaver RG, et al. Understanding differences between summer vs. school obesogenic behaviors of children: the structured days hypothesis. *Int J Behav Nutr Phys Activ*. 2017;14:100.
6. MacMillan F, Kirk A, Mutrie N, et al. A systematic review of physical activity and sedentary behavior intervention studies in youth with type 1 diabetes: study characteristics, intervention design, and efficacy. *Pediatr Diabetes*. 2014;15:175–189.

7. Bonora BM, Boscari F, Avogaro A, Bruttomesso D, Fadini GP. Glycemic control among people with type 1 diabetes during lockdown for the SARS-CoV-2 outbreak in Italy [published online ahead of print, 2020 May 11]. *Diabetes Ther.* 2020;1–11.

8. Tornese G, Ceconi V, Monasta L, Carletti C, Faleschini E, Barbi E. Glycemic control in type 1 diabetes mellitus during COVID-19 quarantine and the role of in-home physical activity. *Diabetes Technol Therapeut.* 2020.

9. Beato-Víbora PI. No deleterious effect of lockdown due to COVID-19 pandemic on glycemic control, measured by glucose monitoring, in adults with type 1 diabetes. *Diabetes Technol Therapeut.* 2020.