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Original Article

Effectiveness of diabetes education including insulin injection technique and dose adjustment through telemedicine in hospitalized patients with COVID-19

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ABSTRACT

Aims:: To study the feasibility of diabetes education through telemedicine in patients with diabetes mellitus (DM) hospitalized for coronavirus disease 2019 (COVID-19) management.
Methods:: This was a prospective study of 100 patients with DM who were admitted in a COVID isolation ward for management of COVID-19. Patients managed with multiple subcutaneous insulin injections were eligible. During teleconsultation, diabetes education including insulin injection technique was given by a diabetes educator via a phone call (audio and video) during hospitalization. They were also re-assessed after 2 weeks of discharge from the hospital via teleconsultation or in-person.
Results:: Out of 100 patients, 72.0% had prior history of diabetes while 28.0% were newly diagnosed. The median age of our cohort was 56 years and median duration of diabetes was 7.0 years. Telemedicine as a mode of consult for diabetes education was accepted by 96.0% of patients during hospitalization. At 2 weeks' follow-up, 77.0% patients were following insulin instructions correctly and were satisfied with this mode of consultation.
Conclusion:: Diabetes education using telemedicine as a technology is feasible, acceptable, and effective in the management of most patients with DM. Telemedicine appears to be an effective way to replace routine visits in special situations.

1. Introduction

Over the last decade, several studies have addressed the feasibility and efficacy of telemedicine strategies on the management of diabetes patients. Diabetes education via telemedicine and in-person was equally effective in improving glycaemic control [1]. Studies suggest that telemedicine can be successfully used to provide diabetes education to patients.

However, the real impact of this intervention in general and specific clinical situations is still unknown and poorly documented, as the results are not consistent among different studies. Overall, existing evidence suggests that teleconsultation has the potential in improving glycated hemoglobin (HbA1c) for patients living with diabetes but the overall magnitude of effect is unclear [2,3].

Diabetes has been found to be one of the leading comorbidities associated with fatality in patients with COVID-19. COVID 19 being a highly transmissible illness, a significant shift of healthcare towards 'telemedicine' is also on the rise [4]. Therefore, we aimed to study the effectiveness of telemedicine on education regarding insulin injection technique, diet counselling and self monitoring of blood glucose (SMBG) in patients admitted in an isolation ward due to COVID-19.

2. Methods

This was a prospective study on a sample of 100 patients with severe acute respiratory syndrome coronavirus-2 (SARS-Cov-2) infection and diabetes who were admitted in Medanta the Medicity Hospital, Gurugram between July 2020 to September 2020. Patients were referred to endocrinology department by the COVID team through telemedicine. All patients were managed with multiple subcutaneous insulin injections (three or more doses per day). Demographic, and biochemical data were noted from EMR

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Table 1
Characteristics of patients with pre-existing diabetes (group 1) and patients with newly detected diabetes after COVID-19 (group 2).

Characteristics	Total (n = 100)	Group 1 (n = 72)	Group 2 (n = 28	*p* value
Age, Years	56 (27–83)	57 (27–81)	55 (28–83)	0.41
Diabetes duration, years	7.0 (1–30)	10.2 (1–30)	–	–
Height, *Cm*	163 (150–180)	162.61 (150–180)	164.6 (154–176)	0.16
Weight, Kg	74.5 (50–105)	74.32 (51–105)	74.96 (50–104)	0.8
BMI, kg/m^2	28.22 (20.4–41.6)	28.40 (20.4–41.6)	27.74 (21.09–39.5)	0.49
HbA1c, %	8.13 (5.5–13.4)	8.46 (6.1–13.4)	7.27 (5.9–10.20)	0.001
Fating plasma glucose, mg/dL	150.3 (80–266)	156.23 (80–266)	134.96 (102–201)	0.012
Thyroid Stimulating Hormone (TSH), mIU/mL	2.90 (0.01–26.8)	2.76 (0.01–16)	3.25 (0.33–26.8)	0.51

Data are given as median (IQR); BMI, body mass index.

(electronic medical record). Diabetes history including previously prescribed medication, their awareness about diabetes, reaction to COVID-19 and acceptance of telemedicine as a mode of consult was recorded through teleconsultation (audio and video). Education regarding insulin injection technique, insulin dose adjustment, and SMBG were given by a diabetes educator via a phone call (audio and video) during hospitalization. They were again assessed after 2 weeks of discharge from the hospital via teleconsultation or in person. The study was approved by the Institutional Ethics review board (MICR-1147/2020, Gurugram, Haryana, India) and was approved by the Ethics Committee. Informed consent was obtained from all participants. The study protocol was conducted according to the Helsinki Declaration.

3. Results

In the present study, out of 100 patients, 72% had pre-existing diabetes (group 1) whereas 28 patients (28%) had elevated plasma glucose levels first time detected in the hospital (group 2). The median age of our cohort was 56 years (IQR, 27–83) and median duration of diabetes was 7.0 years (IQR, 1–30 years) (Table 1). Regarding comorbidities, 49% patients had hypertension and 13% had dyslipidemia (Table 2). 51% times consultation was done directly with the patient and 45% times it was done with both patient and the attendant(s). The mode of telemedicine, time of telecommunication, procedures done and individuals involved are summarized in Table 3. Out of 100 patients, 55% patients were aware about the symptoms of hypoglycaemia at baseline. Following reassessment at week 2 following hospital discharge, 92% had clear ideas about hypoglycemic symptoms and corrective measures (Table 4). During discussion with the patients via teleconsultation, it was observed that 56% patients were aware that people with diabetes had a higher chance of experiencing serious complications if infected with COVID 19 and other 44% had no idea about the relationship between diabetes and severity of COVID-19.

Most of the patients accepted and had understood instructions for insulin injection, insulin doses, SMBG and diet as assessed following 2 weeks by the same diabetes educator (Table 4). Feasibility of telemedicine as a mode of consult was appreciated and accepted by 96.0% patients. However, the remaining 4.0% preferred face-to-face interactions.

4. Discussion

This study suggests that telemedicine is an effective means of providing diabetes education to patients, especially where face-to-face interaction is not feasible, such as in times of highly contagious pandemic. During teleconsultation, diabetes education and insulin administration techniques were explained to the patients. Several researches have shown that comprehensive diabetes education delivered via telemedicine is as good and accepted as in-person education [1]. In our study, patients were educated about the type of insulin, injection technique and action of insulin they have been prescribed. During teleconsultation, education was provided through video calls, voice calls, chat, and educational videos.

It was felt early during 2020 that telemedicine as a mode of consultation is required, due to pandemic of COVID-19, when face-to-face consultation was not feasible [4]. Patient satisfaction with telemedical access to specialty services in rural California study suggests that telemedicine is acceptable to patients as a method of improving access to specialty expertise, and compares favourably with face-to-face care [5]. Patient satisfaction with tele-diabetes education in Hong Kong results showed that diabetes education conducted via telemedicine was highly acceptable to patients with diabetes [6]. In our study, 96.0% patients accepted teleconsultation at the onset, and at re-assessment after 2 weeks of discharge from the hospital, 77.0% patients were following instructions correctly. This suggests that teleconsultation could be an effective mode of consultation in special situations, such as pandemics, when face-to-face interactions are not feasible. In a recent Italian study, Boscari and colleagues demonstrated that telemedicine for a cohort of individuals with type 1 diabetes improved glycemic control [7]. The study concludes that a structured telephonic visit appears to be an effective way to replace or integrate routine visits in special situations, such as COVID-19 pandemic [7]. In another Italian study, adults with type 1 diabetes using hybrid closed loop system and

Table 2
Comorbidities of patients with pre-existing diabetes (group 1) and patients with newly detected diabetes after COVID-19 (group 2).

Comorbidities	Total (n = 100)	Group 1 (n = 72)	Group 2 (n = 28)
Hypertension	49 (49.0)	37 (51.4)	12 (42.9)
Dyslipidaemia	13 (13.0)	11 (15.2)	2 (7.2)
Coronary artery disease (CAD)	3 (3.0)	3 (4.2)	0 (0.0)
Primary hypothyroidism	5 (5.0)	4 (7.0%)	1 (6.7%)
Chronic kidney disease (CKD)	2 (2.0)	2 (2.8)	0 (0.0)

Patient was considered to have hypertension if the blood pressure was ≥140/90 mmHg, if the patient was taking anti-hypertensive drugs or if there was positive medical history. Dyslipidemia was defined as positive medical history, use of lipid-lowering drugs or if the serum low density lipoprotein (LDL) cholesterol level was >100 mg/dL. Hypothyroidism was defined as positive medical history, use of thyroxine or if the serum TSH level was >10 mIU/L. Established CAD was defined as a positive history of angioplasty and/or coronary artery bypass graft surgery. Chronic kidney disease was defined as estimated glomerular filtration rate <60 $ml/min/1.72^2$.

Table 3
Mode of telemedicine, purpose of consult and the individuals involved.

	Mode of telecommunication	Time of communication	Purpose of consult	Individuals involved
1st contact	Phone, or WhatsApp, or Zoom (whichever available)	Real time, audio or video (as per patient comfort) (10:00 a.m. to 2:00 p.m.)	Diabetes history, Previous diabetes medicines, Previous diabetes control, Recent insulin regimen Insulin injection technique, SMBG, Maintenance of glucose chart	Consulting doctor, diabetes educator, patient and attendant(s).
2nd contact (next day)	Phone, WhatsApp, zoom	Real time, audio or video (10:00 a.m. to 2:00 p.m.)	Inspection of glucose levels Adjustment of insulin dose, Insulin injection technique (reinforcement), Hypoglycemia education	Diabetes educator, Patient &/or attendant
3rd contact (one day before discharge)	Phone, WhatsApp, zoom	Real time, audio or video (10:00 Am to 2:00 p.m.)	Insulin dose adjustment (needed because of tapering steroids in many patients), Hypoglycemia education	Consulting physician, Diabetes educator, Patient &/or attendant
4th contact (1 week after discharge)	Phone, WhatsApp, Zoom	Real time, audio or video (10:00 Am to 2:00 p.m.)	Insulin dose adjustment, SMBG, Maintenance of glucose chart	Consulting physician, diabetes educator, Patient &/or attendant
5th Contact (2 weeks after the discharge)	Phone, WhatsApp, Zoom	Real time, audio or video (10:00 Am to 4:00 p.m.)	Several patients required deprescription of insulin, Oral glucose lowering agents prescribed, Monitoring of glucose scaled down (once or twice a day)	Consulting physician, Diabetes educator, Patient &/or attendant

These five contacts were for all patients. Several patients required additional consults in-between, because of rapidly changing steroid doses.

Table 4
Baseline tele-education and reassessment after 2 weeks.

	Total	Group 1	Group 2
Education provided through telemedicine, n	100	72	28
Apparently understood and accepted all instructions, n (%)	96 (96.0)	71 (98.6)	25 (89.3)
Reassessed after 2 weeks, had understood insulin injection technique correctly, n (%)	74 (74.0)	68 (94.4)	22 (78.6))
Knowledge about connection between diabetes and severity of COVID-19	56 (56.0)	46 (63.8)	10 (35.7)
Knowledge about connection between diabetes and severity of COVID-19 at reassessment after 2 weeks	98 (98.0)	72 (100.0)	26 (92.9)
Knowledge about hypoglycemia at baseline	55 (55.0)	48 (66.7)	7 (25.0)
Knowledge about hypoglycemia at 2 weeks	92 (92.0)	68 (94.4)	24 (85.7)

followed by telemedicine showed improvements in most of the metrics of glucose control during the COVID-19 lockdown [8].

Teleconsultation is however facing many challenges. Patients in India are conventionally used to physical visits to hospitals/clinics and may find it difficult to accept a medical advice being conveyed over telephone [4]. Internet services are still not widely available in many rural areas, hence depriving them of teleconsultation services. Patients might not be able to operate smartphones by themselves [9]. In our study, several patients (n = 16) were dependent on their children for operating video-consultation devices.

Our study has several strengths. First, the decision about insulin prescription and subsequent dose adjustments were done in close cooperation between consulting physician, diabetes educators and conveyed to the patients &/or their attendants in real time. Another strength of our study is all patients were prospectively recruited for the study. All patients had COVID-19 and diabetes, which makes the group homogeneous and in-group comparison was possible. The limitation of our study is that we do not compare it with patients who had in-person consultations. This was because during the COVID-19 pandemic, in-person consultations with COVID-19 positive patients was discouraged. Another limitation of our study was that we did not measure any hard outcome indicator, such as glycated hemoglobin. This was because of the short duration of the study (two weeks). Changes in glycated hemoglobin would have been minimal. Another reason for not measuring any hard indicator was because our patients were on corticosteroids and insulin doses were requiring rapid changes.

5. Conclusions

Telemedicine is an admirable mode of consultation for diabetes education and treatment as it diminishes the barrier between health care provider and patients. During the current pandemic, telemedicine has proved to be a well-suited option for both health care workers as well as patients. Our study suggested that diabetes education via telemedicine is a reliable mode of consultation in hospitalized patients with COVID-19. Further studies are needed to see the real effect of teleconsultation on clinical outcomes.

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Declaration of competing interest

The authors declare that they have no competing interests.

Authors contributions

M.M., M.S.K. formulated the hypothesis and analyzed the data. M.M., T.B., J.S.W performed teleconsultation. C.K., S.K., and P.C. collected data. S.K.M., J.S.W., M.S.K. contributed to drafting of the discussion. M.S.K. prepared the manuscript.

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