State of the art paper

Telemedicine and diabetes during the COVID-19 era

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic affected everyone's life and especially those with chronic conditions, such as diabetes. Therefore, the need for medical care in such populations resulted in identification of new models of health care avoiding physical consultation and reducing the risk of COVID-19 transmission, giving emphasis to telemedicine. There is an increasing amount of studies showing the beneficial impact of the use of telemedicine in patients with type 1 diabetes, while for patients with type 2 diabetes the existing data are limited and conflicting. Therefore, the aim of the present review is to summarize the existing literature data on the impact of telemedicine on the follow-up of patients with diabetes during the pandemic as well as its place in the management of patients with diabetes in the future.

Key words: diabetes management, telemedicine, COVID-19, type 1 diabetes, type 2 diabetes.

Introduction

In December 2019, new cases of severe pneumonia of unknown origin with high fatality, mostly due to acute respiratory distress syndrome (ARDS), were observed in Wuhan, China. On February 11, 2020 the cause of the disease was discovered and named respiratory syndrome coronavirus-2 by the International Committee on Taxonomy of Viruses [1, 2]. Most patients with coronavirus disease 2019 (COVID-19) present with mild or moderate symptoms, including fever, dry cough, fatigue and loss of sense of taste and smell. Severe cases can present with ARDS, multiple organ dysfunction syndrome and lead to death [3, 4]. Since the virus has a tendency to spread through droplets, the only option to prevent its spread, at the beginning of the pandemic, was to impose lockdowns, social distancing, travel restrictions, and reduction of hospital visits [5]. Early studies showed that older patients with COVID-19 and comorbidities, including diabetes, showed increased morbidity and mortality, making the need for good glycemic control and close follow-up of great importance [6, 7].

The COVID-19 pandemic has forced patients with diabetes to reduce routine hospital visits with the risk of losing glycemic control and increasing diabetic complications. Under the pressure of the COVID-19 pandemic, the need for medical care in such populations resulted in identification of new models of health care avoiding physical consultation and reducing the risk of COVID-19 transmission, giving emphasis to telemedicine (TM). According to the World Health Organization, TM is the delivery of health-

care services, where distance is a critical factor, by all health-care professionals, using information and communications technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and the continuing education of health-care workers, with the aim of advancing the health of individuals and communities. TM was established as a way of "safe" follow-up of patients with chronic diseases, such as diabetes [8].

Therefore, in the present review, we will summarize the existing evidence of the impact of TM on the follow-up of patients with diabetes during the pandemic as well as its place in the future in the management of patients with diabetes.

Types of telemedicine

TM includes synchronous or asynchronous consultation allowing patients at home or at other locations to communicate with their healthcare professionals, using external telecommunication devices, such as mobile phones, tablets or desktop computers, using broadband or digital cellular networks. TM can be classified according to mode (text, video and audio), time (synchronous and asynchronous) and purpose (first and follow-up consultation) of communication and individuals involved in communication [9]. For a chronic disease like diabetes that requires recurrent physician consultation, telemedicine can be a viable alternative for patients seeking medical guidance without the risk of coronavirus infection [10].

Telemedicine and diabetes

The literature data until now show that use of TM is related to significant improvements in HbA_{1c} for patients with type 1 (T1D) and type 2 (T2D) diabetes, compared to standard care, along with patient-reported satisfaction [11–23]. A meta-analysis from China of 35 randomized controlled trials (RCTs) in patients with T2D showed a small, but statistically significant, decrease in HbA_{1c} by 0.37% in the TM group (video, phone and email) compared to standard care [11]. As the authors of the meta-analysis stated, TM could potentially allow for more effective self-management of patients with T2D, though evidence to date is unconvincing [11]. Accordingly, in a Cochrane review, including 21 RCTs recruiting patients with diabetes, a greater reduction of HbA_{1c} by 0.31% was observed in patients with diabetes on TM compared to control ones [12]. In a recently published review, including 46 studies with patients with T2D and T1D, an overall mean reduction in HbA_{1c} was observed in the TM group in both patients with T2D (0.12% to 0.86%) and those with T1D (0.01% to 1.13%) [13]. Higher reduction rates were found for patients

recently diagnosed with diabetes and those with higher baseline HbA_{1c} (> 8%). TM was not found to have a significant and clinically meaningful impact on blood pressure [13]. Finally, a meta-analysis in 3000 patients with T1D and T2D concluded that TM is effective as usual care in managing diabetes, especially T2D, with older age and longer T2D duration being the main predictors of favorable outcomes [14].

It is noteworthy that the digital revolution in the field of diabetes observed during the recent years (insulin pumps, glucose sensors, integrated and closed loop systems, ambulatory glucose profile software and smart phone apps) made the use of TM during the COVID-19 pandemic a useful and easy way for the remote management of patients with diabetes [15]. TM is an easy way to follow up patients with T1D since most of them, mainly the younger ones, are able to generate and send to their healthcare provider their glucose profile reports allowing remote monitoring and consultation [16]. The place that TM has in the management of patients with T1D was confirmed in a global study during the COVID-19 lockdown. About 30% of participants reported that the pandemic had negatively affected their healthcare due to cancelled physical appointments with their healthcare providers, 32% reported no fundamental change in their medical follow-up during the pandemic and 28% received remote care through telephone (72%) or video calls (28%). Among the patients that used TM, 86% found remote appointments useful and 75% planned to have remote appointments in the future [17]. Age and level of education did not appear to influence use of TM, whereas poor glucose control, particularly in males, seemed to negatively affect use of TM [17]. Very important are the findings of a study from Steno Diabetes Center in Copenhagen, in 5000 patients with T1D. The study's results showed that TM was very useful for the remote management of patients during the pandemic. Physical visits were required only in patients with a recent diagnosis of T1D and high-risk patients for diabetic complications [18].

Continuous glucose monitoring (CGM) has been very helpful for remote management of the patient's glycemic profile, especially during the COVID-19 pandemic. In a study in Los Angeles, the combination of TM and CGM (Dexcom G6) was very helpful to achieve glycemic control in two adult patients with T1D [19], one with new onset and the other with established T1D, who were managed effectively virtually for diabetic ketoacidosis and hyperglycemia. Shared glucose data through CGM facilitated frequent insulin dose adjustments, increased fluid and carbohydrate intake, and prevented hospital admissions in both cases. In the case of new onset T1D, most of the education was

done remotely by certified diabetes care and education specialists [19]. A study in Spanish patients with T1D, with a remote follow-up using intermitted scanned CGM (FreeStyle Libre system, Abbott Diabetes Care), showed no deterioration in glycemic control during the lockdown [20]. Additionally, an Italian study in 40 patients (36 with T2D and 4 with T1D) demonstrated the feasibility and efficacy of TM via intermittently scanned CGM at the time of the COVID-19 outbreak in the Milan Metropolitan Area. The results of the study showed a significant reduction of HbA$_{1c}$ at 3 months follow-up during the lockdown period [21]. The same favorable effect on glycemic status was observed in a retrospective study where intermittently scanned CGM data from 101 patients with T1D were evaluated. Patients who attended a TM visit during the lockdown period had a significant improvement in average glucose, glycemic management indicator, time in range, and time above range without significant changes in time below range, number of daily scans or hypoglycemic events. In contrast, there were no significant changes in any of the CGM metrics during lockdown in those who did not attend TM visits [22].

Recently, two case reports were published where TM was effectively applied in the management of T1D. One case report referred to an adult with T1D who used multiple daily insulin injections and the other to a pediatric patient with T1D who used an insulin pump. Both patients used CGM with commercially available analysis software (Dexcom Clarity and Glooko) to generate ambulatory glucose profiles and manage their blood glucose using a combination of e-mail, internet via Zoom, and telephone calls with their healthcare provider [23]. The use of TM as an alternative follow-up tool during the pandemic was confirmed in a study in Turkey, where TM proved to be useful in achieving optimum glycemic control in pediatric patients with new-onset T1D. In line with recent guidelines, time below range < 70 mg/dl (level 1 hypoglycemia) of < 4% and a time below range < 54 mg/dl (level 2 hypoglycemia) of < 1% were achieved in all pediatric patients [24]. It is obvious that TM, while it was already used for the management of patients with T1D, was established during the COVID-19 pandemic as a useful tool for the management of patients with T1D who are able to use the available software and download ambulatory glucose profiles and for whom remote monitoring is possible.

A very interesting finding is that patients with T1D express the willingness to continue with some TM visits after the end of the pandemic. When 126 T1D patients (51% < 40 years old, 50% men, 50% on insulin pumps, and 69% on CGM) were asked about the use of TM during the pandemic their answers were as follows: the exposure to virtual visits has grown about twofold and almost half of the respondents expressed an interest in future usage of a virtual platform. However, most of the patients preferred to use TM in a hybrid manner [25]. In the same study preference to use TM in the future was related to younger age, previous virtual platform experience, and confidence in being able to download data [25]. Similar findings were reported in a recently published study of T1D patients with one year follow-up. About 67% of participants reported a significant increase in TM monitoring with their healthcare provider remotely since the beginning of the pandemic. However, their preference for TM visits instead of in-person appointments in the future was significantly lower, showing the patient's need for in person contact [26].

In the pre-COVID-19 era, TM ha, also been proven useful in the management of patients with T2D compared to physical visits [12]. However, data on TM and T2D during the pandemic are limited while the outcome of the existing studies in terms of glycemic control depends on the study. A study in Saudi Arabia showed a significant positive impact of TM care on glycemic control among high-risk patients with T2D during the COVID-19 pandemic. Over a period of 4 months, HbA$_{1c}$ decreased significantly from 9.98 ±1.33 to 8.32 ±1.31% [27]. Another study using data from primary care showed that remote monitoring of T2D patients in the pre-COVID-19 period resulted in an average 3- and 6-month HbA$_{1c}$ reductions of 1.3% and 1.2%, respectively, compared to 2.0% and 2.2% during the COVID-19 period. The percentage of patients who achieved HbA$_{1c}$ goals was 41.7% in the pre-COVID-19 period versus 54% during the COVID-19 period, showing the importance of TM independently of the presence of the pandemic [28]. Another study showed significant improvement in HbA$_{1c}$ levels with the use of TM in patients with T2D. Patients used live video consultations with healthcare providers for medication management and real-time CGM for remote monitoring of glycemic control. This type of T2d management was associated with a significant improvement in HbA$_{1c}$ with up to 6 months follow-up especially those with uncontrolled T2D [29]. However, the above type of consultation is not used in the daily management of patients with T2D [29]. The findings of a recent study in Saudi Arabia regarding the cost-effectiveness of TM care for patients with uncontrolled T2D during the COVID-19 pandemic are very interesting. TM care was proved to be cost-effective in managing patients with poorly controlled T2D. Patients in the TM care model had a mean reduction in HbA$_{1c}$ levels of 1.82% (95% confidence intervals: 1.56–2.09), while those in the standard care model had a mean reduction of 1.54 (95% confidence intervals: 1.23–1.85) [30].

Finally, another field where TM has beneficial effects is gestational diabetes (GDM). During the pandemic physical visits were difficult to make and risky for a pregnant woman, making TM a safe way to monitor women with GDM. The above was confirmed in a meta-analysis of 32 RCTs showing that the use of TM, compared to standard care, for the follow-up of women with GDM during the pandemic was associated with significant improvements in glycemic control [31]. Perinatal and postnatal outcomes (for the mother and infant) were also reduced by TM interventions [31]. The above was confirmed in a study in Austria using an integrated digital care program during the COVID-19 pandemic in 2020 in 27 GDM patients who showed significantly improved glycemic control [32].

It is obvious that that pandemic revealed the need for more use of TM for the monitoring of patients with either T1D or T2D. It is noteworthy that the proportion of TM visits before the pandemic was < 1%, rising to an average of 95.2% in April 2020, as shown in a study in T1D patients [33]. Zoom was the most popular video platform used and the majority of centers had multidisciplinary teams participating in the video visits [33]. The results from a world-wide cross-sectional web-based survey from 33 countries showed that during the pandemic, the proportion of pediatric patients with T1D receiving TM visits increased from < 10% to > 50%. Overall, 83.3% of healthcare providers reported being satisfied with the use of TM [34]. In addition, TM appears to be a mode of consultation for diabetes education of patients during hospitalization with great satisfaction from patients and healthcare providers [35]. Diabetes education using TM is feasible, acceptable, and effective in the management of most hospitalized patients with diabetes, a need of great importance during the COVID-19 era.

The use of TM in the form of remote appointments increased during the COVID-19 pandemic in patients with T1D and on some occasions in patients with T2D, with high levels of satisfaction. However, a remarkable decline took place after the first wave of the pandemic in the proportion of patients stating a willingness to continue with remote appointments [33]. The above revealed some concerns about the complexity and heterogeneity of the digital platforms to be managed in everyday clinical practice either by the patient or by the healthcare provider. There are concerns regarding specific privacy requirements and data protection policies for remote visits that need to be solved [34]. Challenges with the use of different platforms and the need of extra time still remain to be solved. There are also some socio-demographic and TM-related factors that should be considered in the implementation of care pathways integrating in-person visits with TM. For example, high education level and being unemployed were factors associated with an increased willingness to continue TM in a recent study. On the other hand, older age was negatively related to willingness to continue TM visits [36]. Another concern refers to safety of TM use for routine monitoring of a patient with diabetes, as a first visit for patients with new-onset diabetes and acute illness compared to in person visits. It seems that a personalized approach is still needed since a substantial proportion of patients still shows a preference for in-person diabetes care [33, 34].

Conclusions

TM has been quickly recognized as an invaluable and useful tool during the COVID-19 era in primary and secondary care. Patients with diabetes were one of the groups of patients with chronic conditions to obtain the beneficial effects of TM. TM was useful for the management of patients with T1D and T2D, women with gestational diabetes and new cases of diabetes. TM, apart from minimizing the risk of COVID-19 infection, offered better glycemic control and reduced diabetes distress. In conclusion, a new era of management of patients with diabetes is emerging with patient's education programs and smartphones, CGM and smart insulin pens where TM has the central role. However, the use of TM in daily clinical practice should be considered on an individual basis according to the patient's needs.

Conflict of interest

The author declares no conflict of interest.

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