Telemedicine in the follow-up of diabetic patients: Utility and effectiveness studied in lockdown

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Abstract- *Introduction:* Telemedicine has found renewed interest during the lockdown period caused by the COVID 19 pandemic. The aim of this study is to compare variations in the metabolic parameters of diabetic patients followed in consultation and those followed in teleconsultation during the confinement period.
Patients and Methods: This prospective study took place between April and May 2020 and included diabetic patients followed in their consultation, appointment during the confinement period. We excluded patients with less than 2 consultations during the year 2019, and patients who did not attend the consultation after the confinement period came to an end. We compared demographic and metabolic characteristics, treatment compliance, stress level, and change in caloric intake during the confinement period.
Results: We collected 65 patients. Thirty-one were follow-ups at their consultations and 34 were Telemedicine follow-ups. The median age was 62 and 55.5 years, respectively. The sex ratio H /F was 1 and 0.9 respectively and the WT2 was 87.3% and 88% respectively. The median BMI before confinement was 29.5 and 28 kg/m² respectively. There was no significant difference between the 2 groups concerning the increase in caloric intake and the post-confinement variation in weight and HBA1C. Assessment of stress levels and treatment compliance showed significantly higher stress levels and significantly better treatment compliance in the patients followed in consultation.
Discussion and Conclusion: Teleconsultation has allowed us to follow more diabetic patients during the confinement period. With an efficiency comparable to consultation, Telemedicine allows access to regular follow-ups for a large population and facilitates patient/caregiver exchange. Regulations are needed to legalize the exchange, protect data and enhance the value of teleconsultation as an act of care.

Index terms: Telemedicine, diabetes, lockdown.

I. INTRODUCTION:

Since December 2019, a new coronavirus has been identified in Wuhan and was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1].
The World Health Organization (WHO) declared on March 11, 2020, the 2019 coronavirus disease as a global pandemic [2]. Many countries have practiced a lock-down to limit the spread of the COVID-19 infection [3]. Morocco decided to establish containment for 94 days, starting from March 20, 2020.
This confinement had repercussions in patients with diabetes; which is a chronic metabolic condition characterized with hyperglycemia and associated with metabolic complications [4]; like decreased or even cessation of physical activity, increased caloric intake, but also restricted access to care due to hospital overcrowding and restricted discharges. Any or all of these factors can lead to acute or chronic glycemic imbalance and aggravation of diabetes-related co-morbidities.
Telemedicine can help patients connect with their doctors while staying at home, away from hospitals, as travel to hospitals or other health care facilities may increase the risk of exposure to coronavirus infection [5]. As a result, Telemedicine may be useful in managing patients with chronic diseases, such as diabetes, during this pandemic containment period.
The objective of this work is to study the effectiveness of telemedicine follow-up by comparing the anthropometric, metabolic, and biological parameters of diabetic patients followed in consultation and those followed in teleconsultation during the confinement period.

II. METHODOLOGY:

1. Study design:
This is a prospective study between April and May 2020 including diabetic patients followed at the consultation with an appointment during the confinement period. We excluded patients with less than 2 consultations during the year 2019, and patients who did not attend the consultation after the confinement was lifted. We compared demographic, metabolic characteristics, treatment compliance, stress level, and change in caloric intake during the confinement period.
2. Definitions
We considered the weight and height of patients taken during the consultation before and after confinement. They were measured using standard equipment. Weight was measured to the nearest 0.5 kg [6]
Treatment adherence was assessed using a self-administered questionnaire derived from the Morisky-Green Medication Adherence Questionnaire (MAQR) [7]

Caloric intake was assessed by a 24-hour recall.
The stress level was assessed by the stress perception scale [8].
Glycemic control was assessed by the HbA1c study treated by the HPLC technic
Acute complications of diabetes are blood glucose levels below 0.7g/l or above 4g/l or the occurrence of diabetic ketosis.
Teleconsultation:
We have considered as teleconsultation any consultation carried out via the Visiomedica platform.

3. Data Collection

We extracted the demographic information, anthropometric parameters and initial biological parameters of all diabetic patients followed in the consultation at Sheikh Khalifa Hospital during the period of confinement via conventional consultation, or teleconsultation through the Visiomedica platform and collected the same information in conventional consultation after confinement.

4. Measuring Results

Data from diabetic patients followed within our structure was compared with data from the same patients in post-confinement to study any differences in the demographic characteristics, anthropometric parameters and biological parameters and the impact of remote monitoring by teleconsultation on these parameters.
We described the age, co-morbidities, known diabetes complications and treatment of patients.
Caloric intake is considered increased if the pre-confinement caloric intake grows by more than 30%.
We studied the stress level using the stress level scale.
*Score below 21: This is a person who knows how to manage his stress, how to adapt and for whom there are always solutions.
*Score between 21 and 26: This is a person who generally knows how to cope with stress but is currently experiencing emotional turmoil.
*Score above 27: Life is a constant threat to this person.
Adherence to therapy was considered good for those scoring 8 or higher, average for those scoring 6 or 7, and low for those scoring less than 6. [7]
We collected the number of acute complications based on patients' self-monitoring logs.
We compared weight, body mass index and HBA1C before and after lock-down.

5. Statistical Analysis

The data was analyzed using SPSS (V.20.0). A value of $p < 0.05$ was considered statistically significant. The study of the normality of distribution of continuous variables was performed by the Kolmogorov-Smirnov test. An independent sample t-test was applied to analyze normally distributed data and the Mann-Whitney test was applied to analyze normally undistributed data. A paired sample t-test was used to compare quantitative variables before and after containment. The $\chi 2$ test and the Fisher test were applied to examine categorical data.

III. RESULTS:

1. Patient Demographics:

We collected 65 patients.
Thirty-one of them were followed up at the conventional consultation, i.e., 48% (group 1) and 34 were followed up by telemedicine, i.e., 52% (group 2).
The median age was 62 and 55.5 years, respectively (p=0.77).
The sex ratio of M/F was 1 and 0.9, respectively (p=0.60) (Table 1).

2. Background:

Type 2 diabetes accounted for 87.3% and 88% respectively in each group (p=0.43).
Patients on insulin therapy accounted for 64.5% and 70.5% respectively in each group (p=0.09).
Patients on oral anti-diabetic drugs represented 35.48% in the conventional consultation group and 26.47% in the teleconsultation group (p=0.49).

In the conventional consultation group, patients had more cardiovascular risk factors (64.51% versus 32.35%) (p=0.05) and more chronic complications of diabetes than in the teleconsultation group (51.6% versus 17.64%) (p=0.04) (Table 1).

3. Metabolic parameters of patients before containment:

Mean weight was 79.86 (15.03) in the conventional consultation group and 76.58 (12.93) in the teleconsultation group (p=0.47).
The median pre-containment BMI was 29.5 kg/m² in the conventional consultation group and 28 kg/m² in the teleconsultation group (p=0.31).
The average hba1c is 7.9% in the conventional consultation group versus 7.79% in the teleconsultation group (p=0.83) (Table 1).

4. Analysis of patients' experiences during confinement:

*Assessment of stress level:
The high-stress level in 25% of the conventional consultation group and 9% of the patients in the teleconsultation group ($p<0.05$) (Table 2)
*Evaluation of therapeutic adherence:
In the conventional consultation group, 87.09% of patients were poorly compliant versus 29.4% in the teleconsultation group ($p<0.05$) (Table 2).
*Occurrence of acute complications:
Patients followed in teleconsultation had more hypoglycemia (14.7%) than those followed in conventional consultation (9.6%) (p=0.42), while episodes of hyperglycemia and ketosis were quite similar in both groups (p=056; p=0.42 respectively) (Table 2)

5. Analysis of metabolic parameters in post-lockdown

*Metabolic parameters:
Weight gain occurred in 64.5% of patients in the conventional consultation group versus 58.8% in the teleconsultation group (p=0.41). The change in mean weight was +0.5 in the conventional consultation group compared to +0.44 in the teleconsultation group (p=0.58).
In the conventional consultation group, 49.90% of patients had an hba1c greater than 8% in post-confinement, versus 41.20% of patients in the teleconsultation group (p=0.32). The change in mean hba1c was +0.19% in the conventional consultation group versus an increase of +0.12% in the teleconsultation group (p=0.02).
There was also an increase in caloric intake of 29.03% in the conventional consultation group, versus 29.41% in the teleconsultation group (p=0.58).

Table 1: Demographic analysis, history and metabolic parameters of patients before lockdown

	Total (n=65)	Conventional consultation (n=31)	Teleconsult (n=34)	P-value
Demographics				
Age, median (IQR), years	60 (52-66)	62 (55-66.5)	55.5 (47-64)	0.77
Sex ratio H/F	0.95	1	0.9	0.6
Medical history				
Type 2 diabetes mellitus, n (%)	56 (87.65)	27 (87.3)	29 (88)	0.43
Oral antidiabetic treatment n (%)	20(30.76)	11(35.48)	9(26.47)	0.49
Insulin treatment n (%)	44(67.69)	20 (64.51)	24 (70.58)	0.09
Other vascular risks n (%)	31 (47.69)	20 (64.51)	11 (32.35)	0.05
Chronical complications of diabetes n (%	22 (33.8)	16 (51.6)	6(17.64)	0.04
Metabolic parameters before lockdown				
Weight medium (SD),%	78.12 (13.94)	79.86 (15.03)	76.58 (12.93)	0.47
BMI median (IQR), kg/m²	28.5 (27-31.5)	29.5 (28-32)	28 (25-30)	0.31
A1c medium (SD),%	7.84 (1.08)	7.9 (1.09)	7.79 (1.09)	0.83

Table 2 : Parameters analyzed during lockdown and variation of metabolic parameters in post-lockdown

	Total (n=65)	Conventionnal consultation (n=31)	Teleconsult (n=34)	P-value
Analysis of patients' experiences during confinement				
High-stress level n (%)	34 (51.50)	25 (80.6)	9 (26.47)	<0.05
Poor adherence to treatment n (%)	37(56.92)	27 (87.09)	10 (29.40)	<0.05
Diabetes complications n,(%)	22(33.84)	16 (51.60)	6(17.64)	0.04
hypoglycemia n,(%)	8(12.30)	3 (9.60)	5 (14.70)	0.42
hyperglycemia n,(%)	2(3.07)	1 (3.20)	1(2.94)	0.56
Diabetic ketosis n,(%)	3(4.51)	1 (3.20)	2 (5.80)	0.42
Variation of metabolic parameters after lockdown				
Weight gain n (%)	40 (61.50)	20 (64.50)	20 (58.80)	0.41
Weight change, medium (SD)	+0.47 (2.43)	+0.5 (2.50)	0.44 (2.40)	0,58
A1c>8%, n (%)	29 (45.30)	15 (49.90)	14 (41.20)	0.32
A1c variation %, medium(SD)	+0.15 (1.07)	+0.19 (1.30)	+0.12 (0.70)	0.02
Increased calory intake n (%)	19(29.23)	9 (29.03)	10 (29.41)	0.58

IV. DISCUSSION

The Coronavirus 2019 (COVID-19) pandemic is an epidemiological event that marks medicine and its actors [9] and lock-down is a very important step in limiting the spread of CoV2 SARS infection [10].

The contribution of telemonitoring for chronic conditions such as diabetes, the use of platforms for transmitting patient data and providing advice, had been booming for people with diabetes for some years [11], so during this lockdown period, telemedicine is a useful tool for managing patients with diabetes [12].

This situation hindered access to health care, limited face-to-face visits in hospitals and threatened the follow-up of diabetic patients during lockdown. To overcome this situation, telemedicine appeared as a feasible and structured alternative to diabetic patients face to face follow-up in the context of the COVID-19 pandemic [13]

In our study, we compared diabetic patients followed in conventional consultation (group 1) and patients followed by teleconsultation (group 2), considering demographic and metabolic characteristics, treatment adherence, stress level and variation in caloric intake during confinement.

Patients followed in conventional consultation have more cardiovascular risk factors and more chronic degenerative complications of diabetes and have significantly higher stress levels and poor adherence to therapy compared to those followed by teleconsultation. This may explain the increase in hba1c, which was greater in the conventional consultation group (group 1).

A New York meta-analysis by Huey Lee and colleagues of all randomized controlled trials that evaluated the effect of telemedicine follow-up on glycemic control in type 2 diabetes found a decrease in HbA1c in the telemedicine group by 0.77%, compared to the control group. Of all the different types of telemedicine interventions tested in the trials, tele-education interventions appeared to be the most effective (-0.71% HbA1c; $p < 0.05$). The other types of interventions (telemonitoring: simple monitoring, teleconsultation: risk stratification for referral, tele management: therapeutic decision) were associated with a decrease in HbA1c of approximately 0.30-0.40%, but none were significant [14].

A Chinese meta-analysis comparing two similar groups showed a 0.37% ($p < 0.001$) reduction in HbA1c in the telemedicine group compared to the control group [15].

In a Cochrane study by Flodgren and colleagues, a reduction in HbA1c of 0.31%. ($p < 0.001$) was observed in patients monitored by telemedicine compared to the control group [16].

In a Strasbourg study conducted during the pandemic, an overall trend of improvement in HbA1c levels was demonstrated, which was more pronounced in the group followed by teleconsultation and particularly in the hospital [17].

There was no significant difference between the two groups in terms of weight change, increased caloric intake and the occurrence of acute complications.

This supports the value of teleconsultation in the follow-up of diabetic patients.

Since the 1990s, numerous American and European studies on the management of diabetes via telemedicine have shown that telemonitoring of diabetes results in better glycemic control, an improvement in biological markers(in this case glycated hemoglobin) good adherence of patients to therapeutic and lifestyle changes, better control of cardiovascular risk factors (hypertension, dyslipidemia, smoking, overweight and obesity), improved quality of life for patients and increased patient responsibility for their disease with good adherence and compliance [18].

The data for each patient should be confidential and stored on the platform level used. Patient consent, whether implicit (i.e., the patient initiated the consultation themselves) or explicit (i.e., someone else initiated the consultation, either the caregiver or the health care worker), must be obtained. The patient's medical record must be kept with the laboratory and radiology reports and the prescription. If the telemedicine consultation is not considered adequate for the clinical assessment, the patient should be called for consultation at an appropriate time and place to avoid the risk of coronavirus infection [19].

At the end, maintaining telehealth as an option post-lockdown has the potential to increase timely and safe access to primary health care for many patients [20].

V. CONCLUSION

Telemedicine is a useful tool for managing patients of diabetes during this lockdown period. However, there is limited data and further research is required. Access to a treating physician must be facilitated to ensure personalized follow-up, especially for chronic conditions such as diabetes, but also to prevent degenerative complications. Our study showed that follow-up by teleconsultation is effective with results comparable to those of patients followed by conventional consultation in a confined space. Telemedicine would allow access to regular follow-up for a large population and would facilitate patient/caregiver exchange.

Several aspects of teleconsultation will, however, need to be clarified. First, it should be valued as an act of care, we have to guard eligible patient profiles, which will require an adaptation in terms of equipment and computer training for patients and caregivers, mainly concerning the security of transmitted data and their confidentiality.

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