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Diabetes Mellitus and COVID-19 at Abass Ndao Hospital Epidemic Treatment Center (ETC)

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Abstract

Introduction: SARS-COV2 infection is a major public health problem and diabetes mellitus is a serious factor. The objective was to determine the characteristics of COVID-19 in diabetics at the Epidemic Treatment Center (ETC) of the Abass Ndao Hospital Center. **Observation:** This was a retrospective, descriptive and analytical study carried out at Abass Ndao Hospital from March 01, 2021 to September 31, 2021. We evaluated the epidemiological, clinical and evolutionary characteristics. **Results:** Among 333 patients infected with COVID-19, 203 were diabetic (60.96%). The sex ratio was 0.70 and the mean age 60.18 years. Diabetes was type 2 (84.2%) and inaugural (15.8%). Arterial hypertension was the main comorbidity (86.96% of cases). The RT-PCR test was positive in 86.21% of cases. The main clinical signs were: asthenia (90.14%), dyspnea (78.81%), cough (52.21%) and body aches (52.21%). Oxygen saturation was <90% in 31.03% of cases. Diabetes was poorly balanced in 71.43% with an average blood sugar of 2.02 ± 4 g/l. At the paraclinical, the D dimer was ≥1000 ng/l (71.52%) and the C-reactive protein ≥100 mg/l (32.01%). Chest CT scan found mild to moderate (55.17%), severe (21.67%) and critical (17.24%) lung lesions. Pulmonary embolism was found in 4 diabetics. The treatment of diabetes was represented by insulin therapy (85.82%) and oral antidiabetics (24.11%). Anti-COVID-19 treatment was dominated by azithromycin (89.11%), corticosteroid therapy (92.11%), anticoagulants (99%), hydroxychloroquine (21.29%). Mortality was found in 14.36% (n = 29) and significantly correlated with age ≥ 60 years (OR = 3.013 [1.266 - 7.173], P = 0.005), short duration of hospitalization (OR = 3.154 [1.149 - 8.663], P = 0.009), C-reactive protein > 100 mg/l (OR = 6.370 [2.704 - 15.006], P < 0.001), lung saturation < 90% (OR = 6.331 [2.633 - 15.222], P < 0.001), lung CT lesions ≥ 50% (OR = 7.855 [3.367 - 18.322], P < 0.001). **Conclusion:** Diabetes is one of the most important comorbidities linked to the severity of SARS-

CoV-2 infection. The seriousness factors in this field remain age ≥ 60 years, lung damage ≥ 50%, CRP ≥ 100 mg/l, and oxygen saturation at <90%.

Keywords

Abass Ndao, Diabetes Mellitus, ETC, SARS-CoV-2, Senegal

1. Introduction

COVID-19 is a pandemic caused by a virus from the Coronaviridae family: SARS-CoV-2 [1]. The pathophysiology of the association diabetes and COVID-19 is characterized by overexpression of angiotensin-converting enzyme 2 in diabetics [2] [3] [4]. This enzyme would preferentially be the binding site of SARS-CoV-2 and could explain a more serious and systemic attack of the disease, particularly in diabetic subjects.

Chinese epidemiological data reported 12% to 22% diabetes among patients with COVID-19 [5]. In the United States, reports from the Centers for Disease Control and Prevention found the prevalence of diabetes at 6%, 24% and 32% in people infected with the SARS-CoV-2 virus, respectively in non-hospitalized subjects, hospitalized in conventional care units and intensive care units [6]. An African study reported a prevalence of diabetes of 11% in patients with COVID-19 [7].

In France, the multicenter Coronado study, carried out as part of the evaluation of the diabetes and COVID-19 couple, reported a profile of diabetic subjects characterized mainly by an average age of 69.7 years, a male predominance (63.7%), arterial hypertension (76.8%), dyslipidemia (46.8%) [8] [9].

In a context that does not predict an imminent exit from COVID-19, the state of health of the Senegalese population has been strongly shaken with a major impact of non-communicable diseases responsible for high morbidity and mortality. In Senegal, no scientific study has been carried out on the association of diabetes and COVID-19. The main objective was to describe the profile of diabetic patients infected with SARS CoV-2 and their evolution at the epidemic treatment center (ETC) of the Abass Ndao Hospital Center in Dakar.

2. Patients and Methods

This was an observational, descriptive and analytical study carried out from March 01, 2021 to September 31, 2021 (a 7 months period). The study was carried out at the Epidemic Treatment Center (ETC) of Abass Ndao Hospital in Dakar, established in March 2021 and officially recognized by the Ministry of Health and Social Action on July 17, 2021.

The study population consisted of subjects hospitalized at the ETC of said hospital for a COVID-19 infection according to the definition of the World Health Organization. Incomplete files and patients who died despite confirmation of the

diagnosis of COVID-19 were not taken into account. The anonymity of the files was respected. Data collected anonymously has been kept confidential. Only those responsible for the epidemic treatment center had access to the data. The approval of the doctor in charge of the ETC and the Ethics Committee of the hospital for Health Research was obtained before the start of the study. A pre-established sheet served as the basis for data collection. It had the following parameters:

Epidemiological aspects: age according to groups, sex.

Study of diabetes: age (diabetes is considered old if the discovery is greater than 1 month), type of diabetes, complications of diabetes, treatment of diabetes and cardiovascular risk factors. Diabetes typing, in the absence of immunology and C-peptide assay, was presumptive based on clinical and evolutionary arguments (age, morphotype, time to onset of symptoms, family history and evolution under treatment). The patients were considered as type 1 diabetics in front of a spontaneous ketosis and especially insulin dependence during the follow-up.

The cardiovascular risk factors taken into account were: age (>45 years in men and 55 years in women), active smoking or smoking less than 3 years, overweight/obesity, arterial hypertension, dyslipidemia. The acute complications of diabetes were: hypoglycemia (decrease in blood sugar ≤ 0.70 g/l), diabetic ketoacidosis (hyperglycemia > 2.5 g/l with positive ketonuria, metabolic acidosis), hyperosmolar hyperglycemia (hyperglycemia > 6 g/l, plasma osmolarity ≥ 350 mosml/l and the absence of acidosis and ketonemia). The glycemic balance at admission was retained in front of a glycaemia < 1.30 g/l or a glycated hemoglobin < 7%.

Clinical and paraclinical aspects of COVID-19: A complete clinical examination had made it possible to find: The reasons for consultation, the hemodynamic constants: blood pressure, pulse, temperature, respiratory rate, oxygen saturation in ambient air, diuresis, capillary blood sugar, ketonuria. Physical signs were sought by examination of all devices and systems. The explorations were carried out according to the terrain. These were mainly: complete blood count, C-reactive protein, blood sugar, glycated hemoglobin, exploration of renal and hepatic functions, D-Dimers, computed tomography with or without injection as the case may be.

Therapeutic and evolutionary aspects: follow-up methods (resuscitation, conventional hospitalization), drugs administered (analgesics, antipyretics, injectable, oral, inhaled corticosteroid therapy, anticoagulants, antibiotic therapy, oxygen therapy). On the evolutionary level, we evaluated the duration of hospitalization, the progressive complications. We systematically looked for organic and vascular complications on a daily basis by the clinic and then, depending on the context, the paraclinical. A patient was declared cured after two negative PCR tests.

A descriptive and analytical analysis was carried out. Data were presented as

percentages for qualitative variables and as averages for quantitative variables. The statistical tests used were the Chi-square test for the qualitative variables and the Student test for the quantitative variables. A $p < 0.05$ was considered statistically significant with a 95% confidence interval (CI). Data entry and processing were performed using Epi info version 7.2.2.2 software.

3. Results

3.1. Socio Demographic Data

Out of a population of 333 patients hospitalized at the Epidemic Treatment Center (CTE) for COVID-19, 203 subjects had diabetes mellitus, *i.e.* a diabetes prevalence of 60.96%. The average age of our study population was 60.18 ± 12 years with extremes of 30 years and 100 years. The predominance was female with a sex ratio of 0.70.

3.2. Study of Diabetes Mellitus

Diabetes was first discovered in 32 patients (15.76%) and old in 171 patients (84.23%). Only one patient had known type 1 diabetes. Mean blood glucose on admission was 3.07 ± 1.4 g/l with extremes of 0.94 and 6 g/l. Diabetes was poorly balanced in 71.43% of cases (145 patients including a simple hyperglycemic imbalance in 61.08% (n = 124), ketosis in 5.41% (11 cases), acid-acid decompensation ketosis in 4.92% (10 cases).

Cardiovascular risk factors associated with diabetes were found in 76.35% (155). These were arterial hypertension (80 cases, 39.40%), age (121 cases, 59.60%), obesity (20 cases, 8.85%), heart disease (6 cases, 2.95%), obliterating arteriopathy of the lower limbs (3 cases, 1.47%), dyslipidemia, chronic kidney disease, smoking in 1 case each. Two cases of cerebrovascular accidents were noted (0.98%). Table 1 shows the distribution according to epidemiological profile (Table 1).

3.3. COVID-19 Study

Clinically, it was mainly asthenia in 90.14%, dyspnea in 78.81%, cough in 52.21%, fever (≥38˚C) in 43.84%, and among them 6.4% had chills, chest pain in 26.60%. So-called specific signs such as ageusia, anosmia or odynophagia were found in 1.97%, 5.91%, 5.41% respectively. Oxygen saturation was <90% in 35.46% (72 cases). The main clinical signs associated with COVID-19 are shown in Table 2.

Biologically, the RT-PCR was performed in all patients was positive in 86.21% (175 cases). The D-dimer level, achieved in 151 patient cases, was greater than or equal to 1000 ng/l in 71.52% (108 cases). C-reactive protein was ≥100 mg/l in 32.01% (65 cases). The other biological abnormalities were anemia in 10.34% (21 cases), hepatic cytolysis in 14.28% (29 cases), hypokalemia in 27.09% (55 cases), kidney failurein 10.34% (21 cases) and electrocardiographic abnormalities in 17.24% of cases (35 cases).

Table 1. Distribution of diabetics with COVID-19 according to epidemiological profile.

Epidemiological parameters	(Number = 203)	Percentage (%)
Middle age	60.18 ± 12 years	-
sex ratio	0.70	-
old diabetes	171	84.2%
Inaugural diabetes	32	15.76%
Average blood sugar	3.07 ± 1.44 g/l	-
Hyperglycemic imbalance	145	71.43%
Normoglycemia	58	28.57%
Comorbidities	155	76.35%
age	121	59.60%
High blood pressure	80	39.40%
Obesity	20	8.85%
Arteritis	3	1.47%
Active smoking	1	0.49%
Chronic renal failure	1	0.49%

Table 2. Distribution of clinical signs in our study population.

Clinical signs	Number (n = 203)	Percentage
Physical asthenia	183	90.14%
Dyspnea	160	78.81%
Cough	106	52.21%
Chest pain	54	26.60%
Aches and myalgias	106	52.21%
Fever with or without chills	89	43.84%
Anorexia	62	30.50%
Headaches	58	28.57%
Intestinal transit disorders	27	13.30%
Rhinorrhea	22	10.84%
Anosmia	12	5.91%
Hiccups	11	5.41%
Odynophagia	11	5.41%
Ageusia	4	1.97%

Chest computed tomography, performed in all patients, was pathological in 94.08% (191 cases). Lung involvement was less than 25% (weak to moderate) in 55.17% of cases (112 cases), between 25% and 75% lung involvement (significant to severe) in 21.67% of cases (44 cases). Achievement was greater than 75% (critical lesions) in 17.24% (35 cases). A CT lesion of pulmonary embolism was found in 1.97% (4 cases). Table 3 shows the distribution of additional signs in our patients.

Table 3. Analysis of factors associated with death in COVID-positive patients.

Parameters		death (n = 29)	Not death (n = 174)	[Odd Ratio] p value
Age ≥ 60 years old	YES	20.59% (21)	46.55% (81)	3.013 [1.266 - 7.173] p = 0.005**
	No	8.25% (8)	53.44% (93)	
Sex	M	51.72% (15)	39.65% (69)	1.630 [0.741 - 3.590] p = 0.116
	F	48.27% (14)	60.34% (105)	
CT scan ≥ 50%	YES	62.06% (18)	17.24% (30)	7.855 [3.367 - 18.322] p < 0.001**
	No	37.93% (11)	82.75% (144)	
Duration of hospitalization	<7 Days	82.75% (24)	60.34% (105)	3.154 [1.149 - 8.663] p = 0.009**
	≥7 Days	17.24% (5)	39.65% (69)	
CRP ≥ 100 mg/l	Yes	68.96% (20)	25.86% (45)	6.370 [2.704 - 15.006] p < 0.001**
	No	31.03% (9)	74.13% (129)	
Free oxygen saturation < 90%	Yes	72.41% (21)	29.31% (51)	6.331 [2.633 - 15.222] p < 0.001**
	No	27.58% (8)	70.68% (123)	
Hyperglycemia	Yes	79.31% (23)	70.11% (122)	1.634 [0.629 - 4.247] p = 0.161
	No	20.69% (6)	29.88% (52)	
High blood pressure	Yes	41.37% (12)	39.08% (68)	1.100 [0.495 - 2.447] p = 0.406
	No	58.62% (17)	60.91% (106)	
Newly discovered diabetes	Yes	10.34% (3)	18.96% (23)	0.756 [0.212 - 2.706] p = 0.356
	No	89.65% (26)	86.78% (151)	

3.4. Therapeutic Aspects

The antidiabetic treatment was noted in 141 patients (69.46%) at the entrance to the CTE, and the rest had no drug treatment. Among those who had an anti-diabetic drug treatment, we found: monotherapy in 53.19% (including insulin therapy in 52.21%), dual therapy in 4.43%, and triple therapy in 3.94%. The oral antidiabetics were a biguanide (16.31%), a sulfonylurea (0.71%), a dipeptide peptidase 4 inhibitor (7.09%). Insulin therapy was used in 85.82% (121 cases).

The symptomatic treatment of COVID-19 included: anticoagulants in 99.00%, analgesics mainly paracetamol in 98.95%, corticosteroids in 92.11%, antibiotics in 100%, zinc and hydroxychloroquine in respectively 86.53% and 21.29% of cases. Oxygen therapy was systematic for all patients with a saturation of less than 95%. Among the antibiotics prescribed, they were macrolides in 89.11% (180 cases), beta-lactams in 193 cases (95.07%) (Including a 3rd generation cephalosporin in 52.48% (106 cases) and an association of amoxicillin and clavulanic acid in 43.07% (87 cases), aminoglycosides were used in 11.35%.

3.5. Evolutionary Aspects

The mean length of hospital stay was 6.27 ± 4.5 days. It was <7 days in 29.08% and ≥7 days in 70.92%. The evolution was favorable in 85.71% of patients (174

cases). A transfer to an intensive care unit was noted in 69 patients (33.99%). Death was observed in 14.36% of patients (29 cases). Death in diabetic patients with COVID-19 was statistically correlated with age ≥ 60 years (OR = 3.013 [1.266 - 7.173], p = 0.005), short duration of hospitalization (OR = 3.154 [1.149 - 8.663], p = 0.009), C-reactive protein > 100 mg/l (OR = 6.370 [2.704 - 15.006], p = 0.000), lung saturation < 90% (OR = 6.331 [2.633 - 15.222], p = 0.000), lung CT lesions ≥ 50% (OR = 7.855 [3.367 - 18.322], p = 0.000) (**Table 3**).

4. Discussion

The limits of our study were the insufficiency of the data, the non-exhaustive recruitment, the absence of a protocol defined beforehand, the selection bias.

4.1. Epidemiological Data

The hospital prevalence of diabetics infected with SARS Cov-2 was 60.96%. This was higher than the data in the literature which varied from 5.3% to 33.9% in China, the United States and Africa [7] [10] [11] [12] [13]. In France, during the first half of 2020, 19,315 people treated pharmacologically for diabetes were hospitalized for COVID-19 in France, *i.e.* approximately 20% of all people hospitalized for COVID-19 during the period [14].

This prevalence difference could be explained by a concentration bias insofar as the Abass Ndao hospital is a reference center in the management of diabetes. In our study, new cases of diabetes accounted for 15.8%. This incidence remains similar to that reported by a meta-analysis by Sathish *et al.* [15] where a result of 14.4% was found.

The phenomenon of new-onset diabetes has already been observed with other viral infections and acute illnesses. The precise mechanisms of new-onset diabetes in people with COVID-19 are not fully understood. But it is likely that a number of interrelated processes are involved, including previously undiagnosed diabetes, stress hyperglycemia, steroid-induced hyperglycemia, and the direct or indirect effect of the cytokine storm occasioned by the COVID-19 on pancreatic cells [16].

The sex ratio in our series was in discordance with the Asian, European and African series [10] [11] [15] [17] [18] [19] [20]. In the West, people with diabetes hospitalized for COVID-19 were mainly men (60.3%). On average, they were subjects in their sixties and over, as evidenced by our series and those of Western [9] [14] and African [10] [11] literature. As already reported in the international literature, the main comorbidity in diabetics infected with COVID-19 was arterial hypertension [5] [6] [9] [10] [11] [17]-[22].

Indeed, advanced age leads to an increase in vascular resistance due to the phenomenon of aging of arterial walls. This could be explained by the fact of the advanced age of the patients and the predominance of arterial hypertension in diabetic subjects. However, Chinese data have highlighted the effect of other morbidities such as smoking, chronic obstructive pulmonary disease, cancer, renal

failure and coronary artery disease [17].

4.2. Clinical Data

The clinical signs were represented in our study by a major triad: asthenia (90.14%), dyspnea (78.81%), and cough (52.21%). This same predominant triad was already reported in Guinea [10] in diabetic patients. On the other hand, in the French CORONADO study [8] [9], fever was at the forefront of the clinical manifestations in diabetic patients with an HbA1c < 7.7%. The low representativeness of fever in our cohort was explained by the fact that our population consisted of poorly balanced diabetics where fever is generally absent in an infectious context.

Oxygen saturation was low (<90%) in 27.94% of cases. In an Algerian study [21], a greater frequency of oxygen saturation disorders was reported in 52% of cases. It was correlated with higher mortality. Indeed, the mortality rate in this patient group was 30.53% in our study. The presence of specific signs such as anosmia and ageusia respectively in 5.91% and 1.97% in diabetics would seem to be less than in non-diabetics. These results were different from those reported in Europe where the prevalence of anosmia and ageusia was 14% in the Coronado study [8] [9].

4.3. Paraclinical Data

Mean blood sugar was 2.02 ± 4.27 g/l. This poor glycemic balance, although less frequent, was observed in Asia [17] [23] and in Africa [10]. Diabetics are at increased risk of infection due to abnormal humoral and cellular immunity deficiencies. Although the mechanisms that link diabetes and immune disorders are probably multiple and complex, several studies point to the bad process exchange between diabetes and COVID-19 [9] [24]. In addition, the high frequency of severe cases of COVID-19 could also be justified by the high prevalence of type diabetes in the elderly. The elderly are very prone to cardio-metabolic pathologies due to senescence phenomena, which could themselves explain the unfavorable evolution of COVID-19 in diabetic patients [25].

In our study, the RT-PCR test was positive in 86.21%. These results were consistent with those of a study, the CORONADO study, where RT-PCR was positive in more than 85% of cases [9]. False negatives could be explained by an insufficient amount of viral material in the sample, a laboratory error or restrictions on the transport of samples. This justifies that certain studies recommended not to take the results of PCR tests as the only indicator for the diagnosis, treatment and isolation of COVID-19 patients.

The frequency of biological abnormalities reported in this study was similar to that observed in the literature [10] [11] [26] [27]. In an Asian study, diabetic patients infected with COVID-19 had a higher risk of inflammatory responses with elevated serum levels of inflammatory biomarkers such as C-reactive protein, D-dimers. A Chinese study [18] drew attention to three variables that would

raise fears of a negative development. These were advanced age, SOFA score and D-dimer level > 1000 ng/ml. However, in our series, only age and C-reactive protein > 100 mg/l were significantly associated with mortality.

Computed tomography occupies a prominent place in the initial diagnosis, especially in the event of negative RT-PCR and for the evaluation of pulmonary lesions [28]. The severity of lung lesions in our study was correlated with literature data [8] [9] [29].

In a Tunisian series [22], moderate to extensive lesions were found in 25% each and severe ones in 36.5%. The most characteristic scan abnormalities of COVID-19 pneumonia were ground glass, multifocal, bilateral areas [30]. The low prevalence of pulmonary embolism was also observed in Tunisia [22] where it was 1.2%.

4.4. Therapeutic and Evolutionary Data

The therapeutic strategy is different depending on whether you are in Africa, Asia or Europe. In our study, the management protocol for diabetic patients infected with COVID-19 was that of the Senegal national program [31]. It was consistent with most COVID-19 management protocols in most African countries [10] [11] [20].

We recorded 14.36% of deaths. Our results were consistent with those of the literature where mortality varies between 5.4% and 35%. This mortality rate, strongly influenced by the diagnostic strategy and the type of population, was all the higher in populations with comorbidities. Reported mortality among diabetics was 7.3% in China [15] [17] [18], 35% in Italy in subjects of a very high average age [12], 24.2% in France [14], in a population hospitalized in intensive care units and 5.4% in Mali [10].

Death was statistically associated in diabetics with advanced age, severe lung damage, increased C-reactive protein and saturation greater than 90%. In the CORONADO study [8] [9], the severity of COVID-19, and in particular the risk of death, appears to be lower in type 1 diabetic patients compared to type 2 (5.4% versus 10.6%, respectively). On the other hand, the risk of death is identical in the oldest (≥75 years), suggesting that the prognosis of COVID-19 is essentially linked to age rather than to the type of diabetes and associated comorbidities.

In the literature, mortality was statistically associated with advanced age, severe lung disease, elevated C-reactive protein [32], and saturation less than 90%. A multivariate analysis [33] revealed that the risk of death was increased by the following factors: advanced age, multivisceral impairment score, plasma levels of D-dimer > 1000 ng/ml on admission.

5. Conclusion

Diabetes was considered a major risk factor for contamination and severe forms of COVID-19. This COVID-19 and diabetes association must be taken seriously

because it constitutes a deleterious association for elderly patients, carriers of a marked inflammatory syndrome and presenting with a severe form. Despite all the knowledge revealed so far, the COVID DIABETE association still hides mysteries.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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