Residência RP Pediátrica
Publicação Oficial da Sociedade Brasileira de Pediatria
ISSN-Online: 2236-6814

Submitted on: 04/18/2021
Approved on: 07/19/2021

CASE REPORT

Diabetic ketoacidosis in a pediatric patient associated a COVID-19: case report

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Keywords:
Diabetic Ketoacidosis, Diabetes Mellitus, Type 1, Coronavirus Infections.

Abstract

The pandemic caused by COVID-19 triggers a disease that manifests itself through flu-like symptoms from mild to severe, up to varied clinical presentations, involving different organs and systems. In pediatric patients, COVID-19 has shown milder manifestations compared to adult patients. The authors report in this article a case that suggest diabetic ketoacidosis (CAD) as the initial manifestation of COVID-19, in a 13-year-old female patient, previously diagnosed with type I diabetes mellitus, admitted to a pediatric emergency room with symptoms CAD compatible, later tested positive for COVID-19. This article discusses the importance of considering COVID-19 infection as a cause of diabetic decompensation in the pediatric population and the possibility of this relationship helping to discover new mechanisms of the disease.

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Residência Pediátrica; 2022: Ahead of Print. DOI: 10.25060/residpediatr-2021.v11n2-616

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INTRODUCTION

The pandemic caused by COVID-19 causes disease that manifests itself through flu-like symptoms of mild to severe intensity, up to varied clinical presentations, involving different organs and systems[1,2]. In pediatric patients, COVID-19 has shown milder manifestations compared to adult patients[3].

Several studies have shown a greater impact of the disease in patients with chronic comorbidities, including diabetes mellitus[4]. Diabetes is one of the most commonly reported comorbidities in patients with COVID-19, being associated with an increased risk of severe infection. Severe metabolic complications of diabetes mellitus such as diabetic ketoacidosis and hyperosmolarity have been observed, demanding exceptionally high doses of insulin used[1,3]. These patients require intensive care admission and/or use of invasive mechanical ventilation and are associated with high mortality rates. They present challenges in clinical management and suggest complex pathophysiology of diabetes mellitus associated with COVID-19[4]. The virus that causes COVID-19 has been observed to bind to angiotensin 2-converting enzyme receptors, located in tissues such as adipose, intestine and pancreas, on pancreatic B-cells. It deteriorates the glycemic balance and promotes the occurrence of metabolic complications such as ketoacidosis[4,5].

There is an increasing number of cases of diabetes, obesity and metabolic disorders in the pediatric population around the world in recent years. Thus, in a pandemic scenario, it is also relevant to consider COVID-19 as a cause of diabetic decompensation in the pediatric population[2,6].

In a pandemic scenario, it becomes relevant to consider COVID-19 as a cause of diabetic decompensation in the pediatric population and this relationship may help to discover new mechanisms of the disease.

OBJECTIVE AND METHOD

Presentation of a case of diabetic ketoacidosis associated with infection caused by SarsCoV-2 in a 13-year-old patient with a previous diagnosis of type 1 diabetes mellitus. Data from the patient's medical records were used for the case report.

The study was approved by the ethics and research committee of the Fundação de Ensino e Pesquisa em Ciências da Saúde/FEPECS, CAAE: 38618620.8.0000.5553.

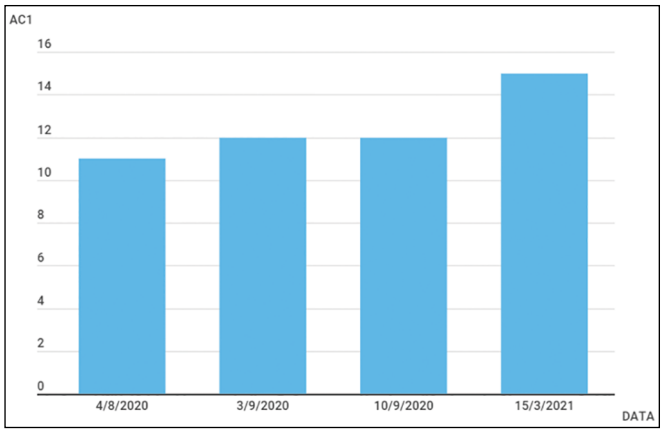
CASE REPORT

Female patient, 13 years old, weight 53kg, with a previous diagnosis of type 1 diabetes mellitus one year ago, without regular follow-up at a pediatric endocrinology outpatient clinic. She sought a pediatric service complaining of vomiting and respiratory distress that had started 03 days ago. Contact report with his mother, who had symptoms of COVID-19 for 07 days.

He makes regular use of NPH insulin (23 units in the morning and 13 units at night), regular insulin (3 units at breakfast, 6 units at lunch and 4 units at dinner) and corrections from 140 mg/dl of blood glucose, with a sensitivity factor of 40. She had only one consultation with the public service since diagnosis, thus limiting information regarding previous glycated hemoglobin (AC1) values.

On physical examination, she was in a serious general condition, pale , dehydrated (+/++++), with Kussmaul breathing, respiratory auscultation without alterations, saturating 97%. She was sleepy, reactive, absent meningeal signs, Glasgow coma scale 14, in addition to weakness in lower limbs. Upon admission, capillary blood glucose (HI), tape ketonuria (++) and arterial blood gas analysis (pH 7,047, potassium of 5.1 and bicarbonate of 6.3) were performed. The diagnosis of severe diabetic ketoacidosis was made, treatment started, guided by the FAMERP[11] (Annex 1) and collection of RT-PCR for SARS COV-2. It remained unstable throughout the morning. Twelve hours after admission, the patient presented with vomiting, tachycardia and Kussmaul breathing , where a new volume expansion was performed at 20ml/kg/h with 0.9% saline, and insulin therapy was maintained in a continuous infusion pump at a dose of 0.1 IU/Kg/h, placed in a non - rebreathing mask at 10 liters/minute. After 1 hour, despite the initial control measures, the patient persisted with worsening breathing pattern and diabetic ketoacidosis (pH 6.89, bicarbonate of 5.1), and orotracheal intubation coupled with mechanical ventilation (parameters: FIO2 100% / PI: 19 / TI: 1.02 / PEEP: 6 / A/C MODE / FR:15: RATIO 1:2.8) and deep venous access in the right subclavian artery. Blood pressure was 104 x 46 mmHg. Laboratory with the following alterations: Blood count with 33,600 leukocytes, being 80.1% neutrophils, 8% rods, 0.1% eosinophils and 14.5% lymphocytes. Ceftriaxone 4g/day was prescribed until the result of the blood culture, 12h later, was negative. The patient remained hemodynamically stable for 10 hours, under sedoanalgesia , without the need for vasoactive drugs. Capillary glycemia, blood gas analysis and insulin doses were monitored, reducing flow to 0.05 IU/kg/h. Transferred to the intensive care unit after 24 hours of hospitalization. The patient evolved with a good clinical response and improved pH and HCO3- levels. After 4 days of treatment, the administration of subcutaneous insulin was started, opting for glargine and ultra-rapid due to the severity of the condition. Hospital discharge followed the improvement of the general condition and the normalization of laboratory tests, 07 days after admission, with negative ketonuria and referral to a pediatric endocrinology outpatient clinic, where follow-up is maintained. The patient's Glycated Hemoglobin (AC1) controls during outpatient follow-up after admission are listed in Graph 1.

The RT-PCR result for SARS COV-2 collected in the first 24 hours of illness was positive.



Graphic 1. Patient's Glycated Hemoglobin Values.

Table 1 shows the laboratory tests performed by the patient, the dates and their respective reference values.

Table 1. Laboratory tests, dates and their respective values of reference.

	Unit	Reference value	30/06/2020
red blood cells	X10+6/uL	3.90-5.30	4.15
VCM	page	80.0- 94.0	97.6
Hemoglobin	g/dL	11.7-15.7	12.4
HCM	page	28.0-30.0	29.9
hematocrit	%	40.0-50.0	40.5
CHCM	g/dL	32.0-36.0	30.6
RDW	%	12.0-17.0	12.3
Leukocytes	X10+3/uL	4.0-14.0	33.6
neutrophils	%	1.2-7.2	80.1
rods	%	0.0-4.0	8.0
segmented	%	30.0-60.0	--
eosinophils	%	1.0-5.0	0.1
Basophiles	%	0.0-3.0	0.6
monocytes	%	2.0-10.0	4.7
lymphocytes	%	30.0-70.0	14.5
platelets	X10+3/uL	150-450	294
Blood culture			Negative
RT-PCR for SARS-CoV-2			detectable
Influenza A			Negative

DISCUSSION

During the early stages of the COVID-19 pandemic, London hospitals reported a higher than usual number of COVID-19 patients developing diabetic ketoacidosis, a hyperosmolar state, a hyperglycemic state, or a combination of both. Very high doses of insulin were often needed to control hyperglycemia. It has been proposed that these metabolic disorders could result from severe insulin resistance combined with decreased insulin secretion due to beta cell dysfunction[7].

For the pediatric diabetic patient, the association with immune pathologies that raise blood glucose, is greater risk of infection and severity. The presence of infection further raises blood glucose and increases the risk of complications such as DKA. Ketoacidosis is the main acute complication of Diabetes Mellitus (DM), and may be the initial manifestation of type 1 DM. The most common precipitating factors are infections and inappropriate use of insulin[8].

In a study carried out with two patients living in California, with type I Diabetes Mellitus, both were effectively treated by telehealth, despite the increased risk of diabetic ketoacidosis (DKA). Shared glucose data facilitated frequent insulin dose adjustments, increased fluid and carbohydrate intake, and prevented hospitalizations in both cases. The presence of COVID-19 has forced dramatic changes in healthcare, some of which improve access and outcomes for patients with diabetes. It is possible that these measures could evolve to provide significant improvements for patients with type I diabetes mellitus and prevent DKA[9].

In a report of two cases of DKA, the authors suggest diabetic ketoacidosis (DKA) as the initial manifestation of COVID-19 in two previously healthy patients, one 11 years old and the other 9 years old, admitted with DKA, later tested positive for DKA. COVID-19. The importance of considering COVID-19 among the possible infectious causes of diabetes decompensation in children and adolescents is emphasized[10].

Faced with a decompensated diabetic pediatric patient, it is important to pay attention to the rapid evolution to CAD and the possibility of association with COVID-19. It is important to evaluate treatment options, remembering that the choice of treatment protocol should always be the best option for the patient[4].

CONCLUSION

It is known that infections, in general, more often lead to diabetic ketoacidosis (DKA) in non-adherent patients like this than in those with good adherence. And due to rapid changes in the conditions of pediatric patients, CAD in a pandemic period, due to its possible association with COVID-19, should be emphasized during treatment. It is important to follow the protocol of the service, make an early diagnosis and use correct treatment, in order to avoid complications and ensure the safety of pediatric patients, in addition to promoting their early recovery.

Thus, there is a need to publish more national or international multicenter studies to elucidate the relationship between COVID-19 and Type 1 Diabetes Mellitus.

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Annex 1. SUMMARY - FAMRP CAD PROTOCOL - 2018[11]:

- Diagnosis: Blood glucose >200mg/dl and pH <7.3 and Bicarbonate <15 and ketonemia > 3 (in the absence of ketonemia at the service, ketonuria > 3 was used).

- Initial treatment:

1. Zero diet;
2. Volume expansion 20 ml/Kg of SF 0.9%, run in a continuous infusion pump, in 1 hour;
3. From the 2nd hour onwards, install a regular insulin infusion pump, 0.1 IU/Kg/h, until capillary blood glucose ≤250 mg/dl;
4. When capillary blood glucose ≤250 mg/dl, decrease insulin infusion pump speed to 0.05 IU/Kg/h;
5. From the 2nd hour onwards, install hydration in an infusion pump, with SF 0.9% + 40 mEq /liter of potassium solution, at a speed of 8 ml/Kg/h, until capillary blood glucose ≤250 mg/dl;
6. When capillary blood glucose ≤250 mg/dl, start SF 0.9% + SG 5% + 40 meq /liter of potassium solution, in the infusion pump, with the same speed of 8 ml/kg/h;
7. Collect venous blood gas analysis with electrolytes, capillary blood glucose and ketonemia / ketonuria of 1/1h, while using an insulin pump.

- Transition phase:

1. If ketonemia / ketonuria < 3 and resolution of acidosis in the blood gas analysis and absence of vomiting: give oral diet and keep in insulin pump at a flow rate of 0.05 Ui/Kg/h.
2. If blood glucose < 200 and good acceptance of the oral diet and clinical stability: administer a regular subcutaneous insulin dose of 0.2 Ui/Kg and stop the infusion pump after 1 hour. After maintaining regular subcutaneous insulin at a dose of 0.1 Ui/Kg every 4 hours and glycemic control every 4 hours.

- Resolution phase:

1. On the following day, leave a correction regimen with regular insulin, at pre - meals, according to capillary blood glucose.
2. One day after starting NPH insulin at a dose of 1/2 to 2/3 of the sum of all regular insulins from the previous day. If the patient is already using insulin, increase the dose by 10%.