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Diabetes during COVID-19 Pneumonia in a 16-Year-Old Girl: A Case Report in Cameroon

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Abstract

Background: Diabetes is a known risk factor for susceptibility and severity of COVID-19 infection. It may also be a complication of COVID-19. Many hypotheses have been proposed to explain this condition. It may be due to the effect of SARS-CoV-2 on β cells or drug-related side effects. In children, there is a paucity of data on the burden of this complication. **Objective:** We aimed to report a case of secondary diabetes during COVID-19 in a pediatric unit. **Case Presentation:** A 16-year-old girl presented with severe respiratory distress. She was treated for COVID-19 infection with antibiotics and corticosteroids. On day 6 of treatment, she developed polyuria and polydipsia. A random blood glucose test showed hyperglycaemia. The diagnosis of secondary diabetes was maintained. **Conclusion:** Covid-19 infection can be complicated by diabetes in children. It is essential to monitor blood glucose levels regularly.

Keywords

Covid-19, Diabetes, Adolescents

1. Introduction

Diabetes is commonly reported as a risk factor for susceptibility and severity of Covid-19 infection. Worldwide, type 2 diabetes is also associated with severe forms of Covid-19 and rapid progression to acute respiratory distress syndrome [1]. Children with type 2 diabetes are 10 times more likely to develop severe disease [1]. In addition, type 1 diabetes has been identified as a risk factor for severe forms of Covid-19 [2]. Furthermore, it is worth noting that type 1 diabetes was

one of the underlying conditions reported in hospitalized children during the pandemic [2].

Rather than being a risk factor, it is becoming increasingly clear that diabetes may be a complication of Covid-19. A new hypothesis suggests that SARS-CoV-2 may affect β cells directly or indirectly, potentially leading to induced diabetes [3]. It is also worth noting that some drugs used in severe forms of COVID-19 may also affect glucose metabolism and cause transient or permanent hyperglycaemia. These include glucocorticoids such as methylprednisolone and, more recently, dexamethasone [4] [5] [6]. We present a case of hyperglycaemia during the course of the Covid-19 pandemic in a 16-year-old adolescent in Cameroon.

2. Case Presentation

2.1. Case History

A 16-year-old female patient was referred from a district hospital for respiratory distress. The patient presented with a four-day history of dry cough, vomiting and fever. She gradually felt tired and had difficulty breathing. She had no previous hospitalization and no chronic diseases such as asthma, sickle cell anaemia or diabetes. The patient had not travelled recently and had not been in contact with anyone with similar symptoms.

The patient was alert and oriented upon admission. The patient presented with dyspnoea and a blood oxygen saturation (SpO_2) of 85% and decreased breath sounds in the right lung with fine crackles. The patient's vital signs were unstable, with a heart rate of 147 beats per minute (bpm) and respiratory rate of 28 breaths per minute. The patient did not present with a fever upon admission. In terms of nutritional status, her BMI was 27.68 kg/m^2 (+1.76 SDS).

The patient was diagnosed with community-acquired pneumonia upon admission. Furthermore, we considered the possibility of Covid-19 pneumonia due to the severity of respiratory distress and the duration of symptoms. The random plasma glucose level on admission was 9.4 mmol/l. The adolescent was treated with a combination of oxygen therapy via a mask at a rate of 5 liters per minute, amoxicillin-clavulanic acid 1 g every 8 hours, zinc tablets 20 mg and intravenous dexamethasone 4 mg every 6 hours. The rapid test for SARS-CoV-2 was negative. The polymerase chain reaction (PCR) test indicated the presence of SARS-CoV-2 antigen. The full blood count indicated the presence of mild, normocytic and normochromic anaemia. The C-reactive protein level was 192 mg/dl. The chest CT scan revealed a ground-glass opacity that covered 70% of the lung parenchyma (**Figure 1**). Azithromycin 500 mg was administered on day 1, followed by 250 mg daily from day 2 to day 5. Enoxaparin was given in preventive doses, along with vitamin C and vitamin D.

2.2. Outcome and Follow-Up

The patient's condition demonstrated a notable improvement, with the absence of fever on day 3 and an enhanced respiratory status. On day 6, the patient

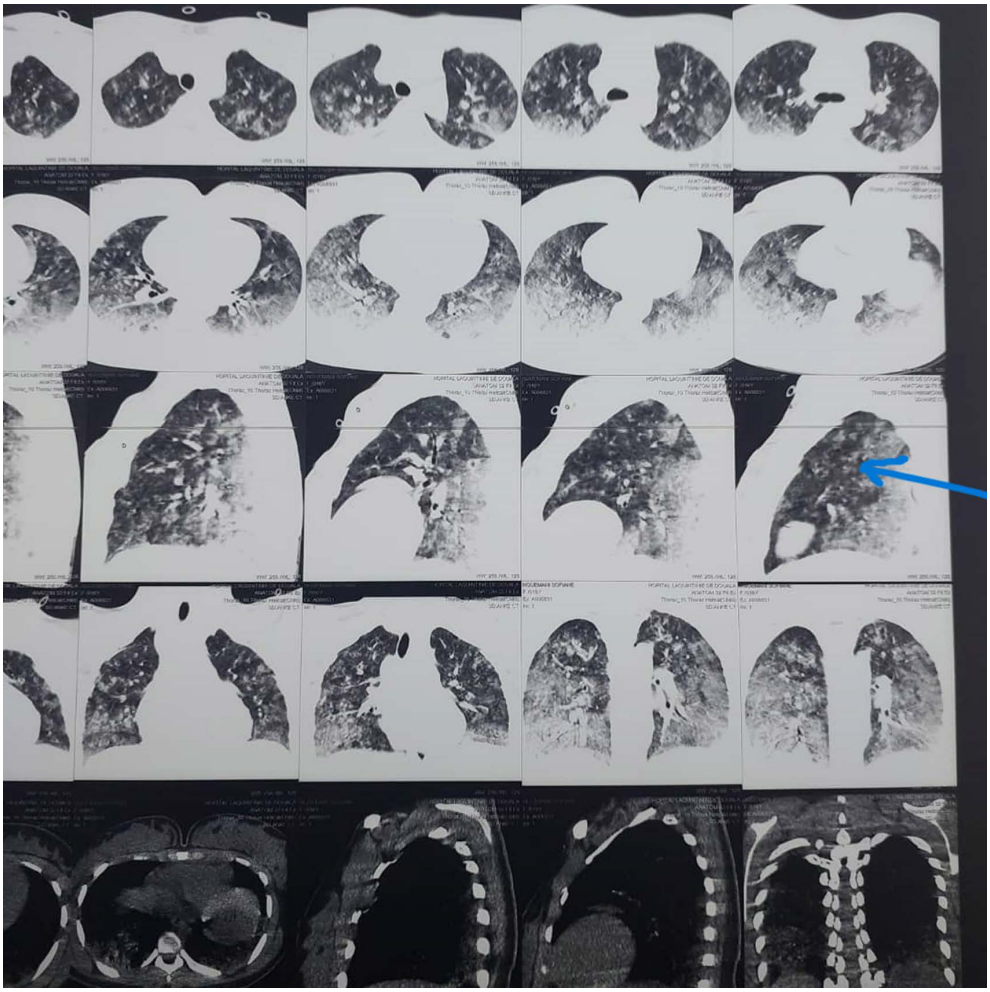

Figure 1. The "ground glass" aspect of the lungs on the chest CT scan.

reported increased urination and thirst. She presented with an intense thirst and a dry mouth. The abdominal skin fold was rapidly disappearing. The random blood glucose level was 31.5 mmol/l. The urine dipstick test indicated the presence of glucose and the absence of ketones. Unfortunately, the glycated hemoglobin result was not available. Given that the blood glucose level was above 10 mmol/l in a critically ill patient, it could be considered as stress hyperglycaemia. Furthermore, the adolescent did not report a history of diabetes or other comorbidities, such as obesity. This hyperglycaemia could also be considered as secondary diabetes, either related to the patient's infection with the novel coronavirus or due to the treatment they have been receiving, particularly glucocorticoids. The hypothesis of stress hyperglycaemia was therefore rejected, as the patient's blood glucose level was within the normal range on admission. Furthermore, hyperglycaemia was observed on the sixth day of treatment, despite the patient's clinical condition having already improved. The hypothesis of secondary diabetes was retained. This could be attributed to the direct effect of the virus or the duration of exposure to glucocorticoids, in the absence of comorbidities.

The treatment of hyperglycaemia without ketosis involved rehydration and

insulin therapy. A fluid deficit of 5% was deemed appropriate, given the signs of moderate dehydration observed during the physical examination. We calculated the maintenance fluid requirement (1500 ml + 20 ml/kg for each kg over 20 kg) plus the fluid deficit (5% of the child's weight) for rehydration. The total volume was administered intravenously (one-third) with normal saline and orally (two-thirds) for 48 hours. Insulin therapy was initiated with premixed insulin (30% insulin aspart + 70% insulin aspart protamine) at a dosage of 1 unit per kg per day, administered in two injections (50 U at 8 am and 26 U at 8 pm). On day seven, we ceased the administration of dexamethasone, azithromycin and enoxaparin. The adolescent's condition improved clinically, with a normal respiratory rate, no signs of dehydration and normal urine output. The urine dipstick no longer indicated glycosuria. The average blood glucose level was 11.27 mmol/l. A follow-up chest CT scan was requested, but not performed due to financial constraints. The rapid test for COVID-19 was negative at the time of discharge.

The patient was discharged after 10 days in hospital on the following medications: insulin premix, rivaroxaban 20 mg, amoxicillin-clavulanic acid tablets and vitamin C. An appointment was scheduled for seven days. At the appointment, the fasting blood glucose was 9.15 mmol/l, and the child gained weight. The next appointment was scheduled for one week later, but the child was lost to follow-up.

3. Discussion

The COVID-19 pandemic started in December 2019 in Wuhan, China. Since this period, every part of the world has been affected. Children are also affected by the virus, although the prevalence of infection in this age group is not yet known [7]. The percentage of positive tests in laboratory studies is 2%. The incidence of severe forms is lower in children than in adults [8]. It is widely reported that severe forms of the disease are more prevalent in infants under one year of age with underlying medical conditions [2] [7]. Our patient did not have any underlying medical condition.

Severe forms can result in complications, including metabolic complications. Hyperglycaemia is typically observed in critically ill patients. It is regarded as a marker of severity [9]. Hyperglycaemia may be transient or permanent. Some studies have indicated that new-onset diabetes may be present at admission. However, our patient's random glucose level was within the normal range at admission.

Given that the hyperglycaemia manifested after 5 days in our patient, we postulated that it was secondary diabetes. There are a number of potential explanations for the development of secondary diabetes during the course of the COVID-19 pandemic. The first mechanism is the direct effect of the SARS-CoV-2 on the pancreatic islets. It is believed that the virus replicates within the pancreatic β cells during the acute phase, leading to direct destruction of these cells. The angiotensin-converting enzyme type 2 (ACE2) receptors are highly expressed in

Langerhans islets. It is then possible that SARS-CoV-2, which has a high affinity for these receptors, could destroy β cells [10]. Conversely, the presence of the virus will result in an increase in the production of stress hormones, including cortisol, epinephrine and glucagon, which will in turn lead to hyperglycaemia [11]. Drugs, especially glucocorticoids, may also affect glucose metabolism during the treatment of COVID-19.

In 2021, the RECOVERY study, a controlled trial conducted in the United Kingdom, reported the benefits of dexamethasone to improve survival in critically ill cases of COVID-19 with 6 mg daily for 10 days [12]. As a result of these findings, dexamethasone was widely adopted in intensive care units for the treatment of these patients. Due to the severity of respiratory distress, our patient also benefited from this treatment. It should be noted that the use of glucocorticoids may induce hyperglycaemia. This side effect is dependent on both dose and duration of use. This is more likely to occur with high doses and long-term use of the drug. Glucocorticoids can lead to insulin resistance at the level of muscles, adipose tissue, and the liver. This is a consequence of defects in the insulin signaling process [5]. In order to prevent glucocorticoid-induced hyperglycaemia, it is recommended to administer adequate doses of dexamethasone and to monitor glucose and glycated haemoglobin.

The treatment of secondary diabetes during the Covid-19 pandemic is not yet fully established. There are a number of treatment options available, including Neutral Protamine Hagedorn (NPH) twice a day, a basal-bolus regimen and basal insulin once a day. In our patient, we used premix insulin, which resulted in a slight improvement during the hospital stay. In Saudi Arabia, basal-bolus insulin has been shown to improve blood glucose levels and survival rates in patients [13]. These options have been used in adults, but there is a lack of data on their effectiveness in children. Further studies should be initiated to gain a deeper understanding.

4. Conclusion

Covid-19 infection seems to be a risk factor of secondary diabetes in children. Direct effect of the virus and corticosteroids' use is suggested as underlying mechanisms. More studies should be conducted in children to learn more about this serious condition.

Authors' Contributions

- **RMB**: managed the patient, collected data, designed the manuscript;
- **CE**: searched the literature, designed the manuscript;
- **SS**: searched the literature, interpreted data, revised the manuscript;
- **BB:** managed the patient, searched the literature;
- **GN:** interpreted data, revised the manuscript;
- **HI:** searched the literature;
- **CP:** designed the manuscript, searched the literature, revised the manuscript.

All authors approved the final version.

Conflicts of Interest

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

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