University Hospitals Sussex
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Improving health outcomes in COVID-19 – Use of Flash glucose monitoring in DKA

Reid I, Kirresh O, Golding J, Parthasarathy S

Correspondence: s.parthasarathy1@nhs.net

Introduction

The current pandemic of Coronavirus Disease 2019 (Covid-19) has been linked to an increased risk of new-onset diabetes mellitus as well as an increased incidence of diabetic ketoacidosis (DKA) either as a new presentation or with pre-existing diabetes (1). Figure 1 explains the probable mechanism by which Covid-19 results in hyperglycaemia.

Managing patients after discharge can pose challenges due to isolation and rapid changes in insulin resistance. Flash glucose monitoring (FGM) has the potential to enable remote monitoring and insulin titration and we describe a case detailing its use.

Case History

A 57-year-old male, who was diagnosed with the Covid-19 one month prior, presented with epigastric pain, exertional shortness of breath and weight loss. Prior to admission, the patient was started on metformin after blood tests demonstrated an elevated blood glucose level (>20mmol/L) and glycated haemoglobin (HbA1c) of 105mml/mol. The patient had a history of essential hypertension and renal stones.

Investigations confirmed DKA (pH 7.22, bicarbonate 12.6mmol/L, blood glucose 11.6mmol/L, blood ketones 5.8mmol/L). The admission HbA1c was 95mmol/mol. Relevant laboratory results are shown below in table 1. All other results were unremarkable. Serum GAD-65 antibodies, serum IA2 antibodies and serum zinc transporter 8 antibodies were all negative.

A plain film chest radiograph demonstrated clear pleural spaces and a subsequent CT pulmonary angiogram demonstrated subtle left lower lobe ground glass changes in keeping with Covid-19 and no pulmonary embolism. CT pancreas triple phase was unremarkable.

Management

Initial treatment with fixed rate intravenous insulin infusion was started as per national DKA guidelines. The patient was discharged on a basal-bolus regime (Total Daily Dose - 30 units) and a FreeStyle Libre FGM device. Rapid improvement in blood glucose levels were observed, with regular down titration of insulin and complete discontinuation of all diabetes therapy after 24 days (Figure 2). At 96 days, Hba1c was 37mmol/mol (Figure 3c). C-peptide were low for paired glucose at 302pmol/L three weeks after discharge, which had normalised at 3 months for paired glucose at 837pmol/L after discharge. The patient had also lost one stone due to dietary changes during this time.

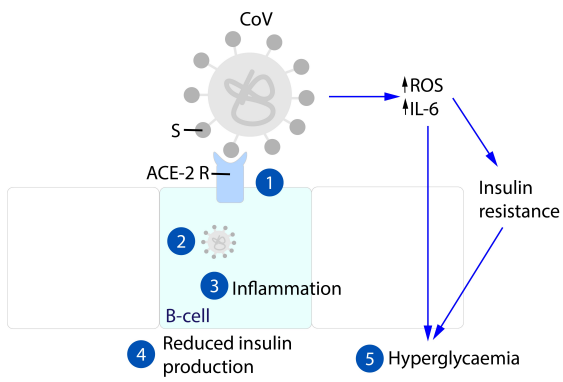


Figure 1: How coronaviruses result in hyperglycaemia; (1) Coronavirus binds to ACE-2 receptor on the beta-cells of the pancreas (2) thereby entering the beta-cell causing (3) inflammation which results in impaired cell function with (4) reduced insulin production and (5) uncontrolled hyperglycaemia ensues. Abbreviations, ACE-2 R: Angiotensin-converting enzyme-2 receptor, CoV: Coronavirus, B-cell: Beta-cell, S: Spike protein. Picture illustration adapted (2)

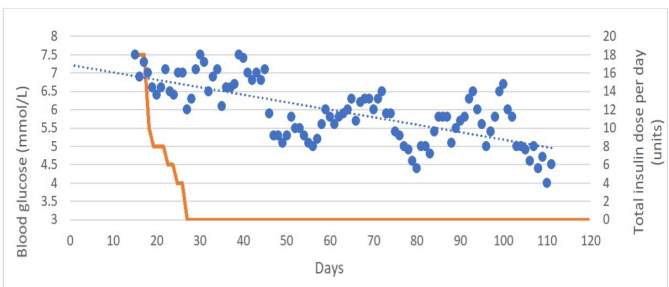
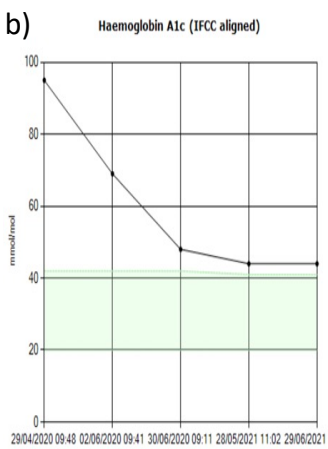


Figure 2 – Chart representing daily average blood glucose reading (blue, left axis) and total daily does of insulin (orange, right axis)

a)

Blood Test	Result	Normal Value or Range
White cells (x 10^9/L)	9.3	4-10
Creatinine (µmol/L)	107	62-106
D-dimer (ug/ml)	1.35	0-0.5
Troponin T (ng/L)	8.67	0-14
C-reactive protein (mg/L)	2	0-5
Procalcitonin (ng/ml)	0.09	0-0.05
Ferritin (ug/L)	1554	30-400
Lactate dehydrogenase (iu/L)	437	240-480

b)



c)

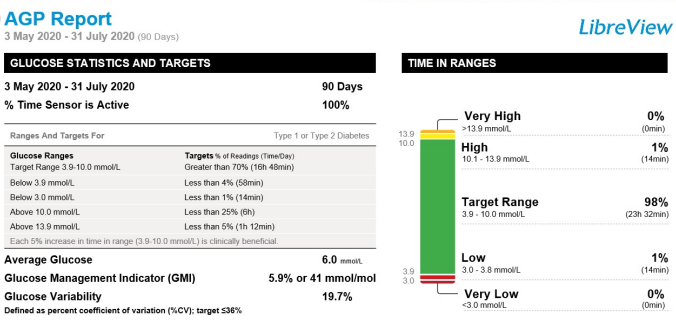


Figure 3: a) table summarising salient laboratory investigations **b)** chart showing patients HbA1c trend from admission to 14 months follow up. **c)** FreeStyle Libre AGP report 3 months after admission.

Discussion

1. This case study illustrates the challenges in context of an acute presentation with DKA and rapidly normalising blood glucose values as the patient recovered from illness.
2. FGM is well established as a safe and effective strategy for management of diabetes (3).The use of FGM enabled remote monitoring and was instrumental in the safe management of our patient with insulin therapy which falls outside the current NHS England eligibility criteria for FGM system use. FGM use enabled us to safely withdraw Insulin therapy.
3. Previous literature has suggested that SARS-CoV infection can induce beta cell dysfunction, resulting in transient hyperglycaemia (4).
4. Although characteristics of patient cohort with DKA in SARS-CoV-2 exists, evidence is lacking for temporal relationship between the inflammatory markers and risk of development of DKA (5). Our patient had raised ferritin until 8 months post presentation.
5. We propose that patients with new diagnosis of diabetes presenting with DKA in context of SARS-CoV2 infection should be discharged with FGM enabled blood glucose monitoring from secondary care. This enables remote insulin titration with ease, de-escalation of treatment with confidence, and avoiding hypoglycaemia in recovery phase of illness in those with transient beta-cell dysfunction due to SARS-CoV2. This can also improve patient satisfaction and could be less resource intensive.

References

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