Symposium Management of Hyperglycemia in COVID-19 Patients on Dexamethasone

December 12th, 2020. Saturday 9pm-1015pm Myanmar 630am-745am USA (California/PST)

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COVID-19 is associated with the worse outcome in diabetes.

- Patients with type 2 diabetes are more likely to have serious complications, more intensive care unit (ICU) admissions, longer length of stay, and death from COVID-19.
- In a retrospective study from the United States, the mortality rate was 28.8 percent in patients with diabetes or uncontrolled hyperglycemia, compared with 6.2 percent without either.

J Diabetes Sci Technol. 2020;14(4):813. Epub 2020 May 9.



Is Covid-19 diabetogenic?

 COVID-19 infection appears to precipitate severe metabolic manifestations of diabetes, including diabetic ketoacidosis (DKA), hyperosmolar hyperglycemic state (HHS), and severe insulin resistance in the patients with or without a history of diabetes.

> Diabetes Metab J. 2020;44(2):349 N Engl J Med. 2020;383(8):789

- Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes Covid-19, binds to angiotensin-converting enzyme 2 (ACE2) receptors, which are expressed in key metabolic organs and tissues, including pancreatic beta cells.
- Is there a potential diabetogenic effect of Covid-19, beyond the well-recognized stress response associated with severe illness?

Bidirectional relationship between diabetes and COVID-19.

On the one hand, diabetes is an important risk factors for severe Covid-19 and mortality.

Hyperglycemia poor outcome in COVID-19

On the other hand, new onset diabetes and severe metabolic complications of preexisting diabetes, including diabetic ketoacidosis and hyperosmolarity, have been observed in patients with Covid-19.

Hyperglycemia COVID-19



COVID-19 : Knowledge in progress

What We Don't Know

• COVID-19-related diabetes:

- Does the alterations of glucose metabolism that occur with a sudden onset in severe Covid-19 persist or remit when the infection resolves?
- How frequent is the phenomenon of new-onset diabetes, and is it classic type 1 or type 2 diabetes or a new type of diabetes?

• Patients with preexisting diabetes:

- Does Covid-19 change the underlying pathophysiology and the natural history of the disease?
- What is the best way to manage hyperglycemia in COVID-19 patients?



An international group of leading diabetes researchers are establishing a Global Registry of COVID-19-related diabetes.

This registry is specifically designed to establish the extent and characteristics of new-onset, COVID-19-related diabetes, and to investigate its pathogenesis, management and outcomes. The Registry also collects data about presentations with severe metabolic disturbance in pre-existing diabetes (DKA, hyperosmolarity; severe insulin resistance).

Given the very short history of human contact with COVID-19, this registry will rapidly help us understand how COVID-19 related diabetes develops, its natural history and its best management. Studying COVID-19-related diabetes may also uncover novel mechanisms of disease. What is the best way to manage steroid-induced hyperglycemia in COVID-19 patients?



Management of <u>steroid-induced</u> hyperglycemia in <u>COVID-19 patients</u> on dexamethasone

What is the best way to manage steroid-induced hyperglycemia in COVID-19 patients?

- The management of diabetes in hospitalized patients with COVID-19 is similar to the management of other hospitalized patients with diabetes, except for
 - the presence of often extreme, labile insulin
 resistance that resolves with improvement in COVID-19, and
 - the need to minimize injection frequency to maximize safety for health care staff.

Symposium Management of Hyperglycemia in COVID-19 Patients on Dexamethasone

Case presentation

Aye Khine, MD Internal Medicine Resident,

UCSF-Fresno





Steroid-induced hyperglycemia (general)

Review

Trends in Endocrinology and Metabolism December 2011, Vol. 22, No. 12



Figure 1. Pathophysiological mechanisms of glucocorticoid (GC)-induced diabetes. GC excess causes inhibition of insulin secretion by pancreatic β cells and reduces insulin sensitivity in liver, skeletal muscle and adipose tissue. NEFA, nonesterified free fatty acids; *, mechanisms involved in determining fasting hyperglycemia.

Mechanisms and effects

- Increased insulin resistance (liver, muscle, adipose)
- Decreased beta-cell function
- Postprandial hyperglycemia More severe than fasting
- Fasting hyperglycemia

Mild initially, more severe with long-acting steroid, frequent steroid dosing, prolonged use of steroid

Cumulative doses can have increasing hyperglycemic effect

Robert A, et al. Diabetes UK Position Statement. Management of hyperglycaemia and steroid (glucocorticoid) therapy: A guideline from the Joint British Diabetes Societies (JBDS) for Inpatient Care group. *Diabet Med* 2018;35:1011–1017.

Equivalent Dosage of Commonly Used steroids

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Glucocorticoid	Approximate Equivalent dose (mg)	Half-life (Biologic) hours
	Short-Acting	
Cortisone	25	8-12
Hydrocortisone	20	8-12
	Intermediate-Acting	
Methylprednisolone	4	18-36
Prednisolone	5	18-36
Prednisone	5	18-36
Triamcinolone	4	18-36
	Long-Acting	
Betamethasone	0.6 - 0.75	36-54
Dexamethasone	0.75	36-54

Prednisone 40mg = Dexamethasone 6mg

Table I. Pharmacokinetics of Commonly Used Glucocorticoids.⁸

	Prednisone and Methylprednisolone	Dexamethasone
Peak plasma concentration	l hour	l hour
Elimination half-life	2.5 hours	4 hours
Hyperglycemic effects		
Onset	4 hours	4 hours
Peak	8 hours	Unknown
Resolution	12-16 hours	24-36 hours

Prednisone 40mg = Dexamethasone 6mg

California Diabetes and Pregnancy Program (CDAPP) Sweet Success Pocket Guide for Professionals ~ 2013

INSULIN ADJUSTMENTS DURING BETAMETHASONE (BMZ) USE ALGORITHM^{16, 17}

Day One: BMZ 12 mg	Day Two: BMZ 12 mg	Days Three & Four:	Day Five:		
Double all insulin doses (TDD) (Basal and bolus)	Continue with doubled doses and modify as needed for (±) Target BG's	Decrease the previous day's increased doses by 50%. and add this to the original dose	Revert to pre betamethasone insulin doses		
For example : If TDD insulin dose before Betamethasone = 50 units Day one = double TDD insulin dose = 100 units Day 2 = same as day 1 = 100 units Day 3 & 4 = half of insulin increase + TDD insulin dose = 25 + 50 = 75 units Day 5 = revert to TDD insulin dose = 50 units					
This algorithm must be individualized to patient response					

Dexamethasone 6mg = Prednisone 40mg



What is the preferred insulin for steroid-induced diabetes?

- The duration of action of NPH closely mimics that of prednisone, reducing the risk of hypoglycemia as the steroid effects wear off.
- NPH insulin **peaks** around the same time that prednisone causes its highest degree of hyperglycemia.

The dotted line represents the pharmacokinetic profile of NPH insulin administered at the same time as the daily glucocorticoid dose to counteract the hyperglycemic effect of the glucocorticoid. The solid line represents the glycemic excursion expected with a glucocorticoid dose ²



Matthew D. Wallace et al. Optimizing the Treatment of SteroidInduced Hyperglycemia. Annals of Pharmacotherapy. 2018, Vol. 52(1) 86–90
 Cecilia C. Low Wang, Practical Approach to Management of Inpatient Hyperglycemia in Select Patient Populations. Hospital Practice, Volume 41, Issue 2

What is the preferred insulin for steroid-induced diabetes?

- NPH insulin is a preferable strategy for insulinnaïve patients because of
 - the simplicity of a once-daily dosing strategy.
 - elimination of meal-time insulin, and
 - no difference in glycemic control compared with insulin glargine.
 - lower cost

Insulin therapy (general)

- Basal insulin **0.2 unit** per kg weight daily
- Prandial insulin 0.1 unit per kg weight per meal
- Adjust the doses by 10-20% frequently



• Why weight-based?

 Insulin resistance has been shown to increase in a linear manner with body weight for patients with a body mass index over 26.8 kg/m².¹

Regression plots of homeostasis model of insulin resistance (HOMA-IR) versus body mass index ²



D. Wallace et al. Optimizing the Treatment of SteroidInduced Hyperglycemia. Annals of Pharmacotherapy. 2018, Vol. 52(1) 86–90
 Ibiye Owei, et al. Insulin-sensitive and insulin-resistant obese and non-obese phenotypes. BMJ Open Diabetes Research and Care 2017

Insulin initiation for steroid-induced hyperglycemia

Method #1



How to calculate insulin dose for steroid-induced diabetes

Initiate weight-based NPH insulin at 0.1 U/kg for every 10 mg of prednisone or every 1.5 mg of dexamethasone up to a maximum of 0.4 U/kg.

Estimation of the initial dose of insulin in steroid-induced hyperglycemia, according to the type and dose of glucocorticoid

Prednisone dose (mg/day)	Dexamethasone dose (mg/day)	Insulin NPH/Glargine dose (units/kg weight per day)
≥40	≥6	0.4 (max)
30	4.5	0.3
20	3	0.2
10	1.5	0.1

- same calculation for glargine/detemir dose
- in single dose in the morning together with once daily prednisone
- in 2 divided doses for twice daily prednisone or dexamethasone.
- Patients already receiving insulin at home should add the weight-based total to their normal basal insulin dose.

How to calculate insulin dose for steroid-induced diabetes

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≥40	≥6	0.4 (max)
30	4.5	0.3
20	3	0.2
10	1.5	0.1



Insulin initiation for steroid-induced hyperglycemia

Method # 2



Bethany Grommesh et al. International Diabetes Center, Minnesota

Low Dose Gluc	ocorticoid dose	High Dose Gluc	cocorticoid dose
10-39 mg Prednisone/ P 40-159 mg Hydrocortise 8-31 mg Methylprednise 1.5-5.9 mg Dexamethas ↓	Prednisolone or one or olone or one/ 24 hours	\geq 40 mg Prednisone/ Pro \geq 160 mg Hydrocortison \geq 32 mg Methylprednison \geq 6 mg Dexamethasone \downarrow	ednisolone or ne or olone or e /24 hours
No Diabetes	Type 2 Diabetes	No Diabetes	Type 2 Diabetes
5 units NPH per glucocorticoid dose*10 units NPH per glucocorticoid dose*		10 units NPH per glucocorticoid dose*	20 units NPH per glucocorticoid dose*

*Full dose NPH given at the same time as glucocorticoid administration *except*:

- Methylprednisolone/ hydrocortisone dosed every 4-6 hours or dexamethasone: Give NPH three times per day at 8 am, 4 pm, and 10 pm. The 10 pm dose reduced 25%.
- If patient is NPO, start dose at 50%

Fig. 3. NPH treatment for experimental group – initial starting dose.DM = diabetes mellitus;NPH =neutral protamine Hagedorn.Glucocorticoid Insulin Protocol, Endocr Pract. 2016;22(No. 2)

Prednisone 40mg = Dexamethasone 6mg 50 Kg (110 pounds) patient

50 Kg (110 pounds) x 0.4 U = 20 U NPH Qam

NPH dose titration

Daily Insulin Titration Schedule

•	Increase NPH dose by 25% If 1 or 2 BGs is >300 mg/dL, increase NPH by 50%	•	If 1 BG is 50-69 mg/dL, decrease NPH dose 25% If 1 BG is <50 mg/dL decrease NPH dose 50%	•	Taper NPH insulin doses with glucocorticoid taper; decrease the NPH same percentage as the glucocorticoid decreases
				•	Stop NPH when glucocorticoid is less than physiologic dose (<10 mg prednisone or equivalent)

Glucocorticoid Insulin Protocol, Endocr Pract. 2016;22(No. 2)

Bethany Grommesh et al. International Diabetes Center, Minnesota

Prednisone 40mg = Dexamethasone 6mg 50 Kg (110 pounds) patient

50 Kg (110 pounds) x 0.4 U = 20 U NPH Qam

Insulin initiation for steroid-induced hyperglycemia

Method # 3



Table 3. Special Considerations for Insulin Therapy in Hospitalized Patients With Diabetes				
	Frequency	Insulin dosing		
Glucocorticoids				
Prednisone or methylprednisolone	Every day	 NPH 0.5 units/mg glucocorticoid (range 0.25–1.0 units) daily administered at the time of the glucocorticoid dose 		
	≥ 2 times per day	 NPH 0.5 units/mg glucocorticoid (range 0.25–1.0 units) in divided doses twice daily OR Use 130–140% of basal and bolus insulin doses in a 30-70 ratio 		
Dexamethasone		 NPH 3 units/mg glucocorticoid equivalent (range 2–5 units) in divided doses twice daily OR Use 140–150% of basal and bolus insulin doses in a 30-70 ratio 		

- 0.25 units of NPH/mg prednisone equivalent (T1D or no prior DM) or BG <200
- If insulin resistant, 0.5 units of NPH/mg prednisone equivalent, max 40 units

Low Wang CC, Draznin B. Insulin Use in Hospitalized Patients With Diabetes: Navigate With Care. *Diabetes Spectrum* 2013;26(2):124-130. Rasouli N, et al. Cystic fibrosis-related diabetes in adults: inpatient management of 121 patients during 410 admissions. *J Diabetes Sci Technol* 2012;6:1038–1044.

Prednisone 40mg = Dexamethasone 6mg 50 Kg (110 pounds) patient

40mg Prednisone x 0.5 U = 20 U NPH Qam

Insulin initiation for steroid-induced hyperglycemia

Method # 4



DOI: 10.1111/dme.13675

Diabetes UK Position Statements

Management of hyperglycaemia and steroid (glucocorticoid) therapy: a guideline from the Joint British Diabetes Societies (JBDS) for Inpatient Care group



Glipizide 5mg qam or bid = Glimeperide 1mg qam = Gliclazide 40 mg qam or bid)

Managing Glucose Control in People with Known Diabetes On Once Daily Steroids (glucocorticoids)

Type 2 diet control OHA +/- GLP1

If no 'hypo' symptoms and NOT on an SU:

- Commence gliclazide 40mg a.m., titrate daily until a maximum dose of 240mg a.m. or glycaemic targets are reached
- Seek specialist advice if you are concerned about dose titration in those taking 160mg with no improvement in glycaemic control
- If on twice daily gliclazide and targets not reached consider referral to specialist care for titration to 240mg morning dose plus 80mg p.m.

Insulin controlled (Type 1 and Type 2). In Type 1 diabetes always test for ketones, if blood ketones more than 3mmol/L or urinary ketones >++ assess for DKA In Type 2 diabetes check for ketones if CBG levels >12mmol/L and the patient has

osmotic symptoms >200 mg/dL

Once daily night time insulin, transfer this injection to the morning:

- Titrate by 10 20% daily according to pre-evening meal CBG readings
- If targets not achieved consider BD, or basal bolus regimen

Twice daily insulin:

- Morning dose will need to increase 10 - 20% daily according to pre-evening meal CBG readings
- Aim for CBGs to individual needs as stated above, unless patient experiences 'hypo' despite snacks

Basal bolus insulin:

- Consider transferring evening basal dose insulin to the morning and increase short / fast acting insulin by 10 - 20% daily until target reached
- Aim for agreed CBGs target to patients needs pre-meal, unless patient has hypo despite snacks or has long gaps between meals

Overall treatment recommendations

- NPH insulin in patients without pre-existing diabetes (QD or BID)
- NPH insulin added on to diabetes regimen (outpatient or basal-bolus inpatient)
- Basal-bolus using a 30-70 ratio
 - Higher doses of meal coverage
- More aggressive rapid-acting insulin correction scale
- Insulin pump therapy: No trials! I start with 120% temporary basal and increase C:I and CR by 20%

Steroid-induced hyperglycemia. Algorithm for hyperglycemia management in patients not previously treated with insulin



From Glucocorticoid-induced hyperglycemia. Journal of Diabetes 6 (2014) 9-20 (with modification)

Note:

30 20

10

- If possible, more frequent BG testing (fasting, before and 1-2H each meal and at bedtime) should be considerd during screeing and dose titration periods.
- OHA and insulin dose should be reduced during steroid-withdrawal to avoid hypoglycemia. Above weight-based inslin dose table may be used as a guide fo insulin dose reduction (to reduce the insulin dose by 0.1 U/kg for every 10-mg reduction in prednisone dose)
- Patients already receiving insulin at home should add the weight-based total to their normal basal insulin dose.

0.3

0.2

0.1

4.5

3

1.5





Table 5 Treatment adjustment in patients previously treated with insulin, considering the usual insulin and glucocorticoids schedule						
Usual insulin schedule	Intermediate-acting glucocorticoids in the morning	Two daily doses of intermediate-acting glucocorticoids	Long-acting or intra-articular glucocorticoids			
Insulin NPH, . or biphasic at dinner or bedtime	Add the estimated increase of insulin as a dose of insulin (NPH, or biphasic) before breakfast	 Add the estimated increase of insulin as insulin NPH, . or biphasic: 2⁄3 before breaskfast 3⁄3 before dinner 				
Basal insulin (glargine/detemir)	Add the estimated increase of insulin as a dose of insulin (NPH, or biphasic) before breakfast		Add the estimated increase of insulin as basal insulin (glargine/detemir)			
Insulin NPH/ biphasic in two daily doses	Add the estimated increase of insulin as insulin (NPH, or biphasic) before breakfast	 Add the estimated increase of insulin as NPH, or biphasic: ²/₃ before breaskfast ¹/₃ before dinner 				
Basal bolus insulin regimen	 Add the estimated increase of insulin as a bolus: 20% before breaskfast 40% before lunch 40% before dinner 	 Add the estimated increase of insulin as: 25% basal. 75% bolus (⅓ in each meal) 				

From Glucocorticoid-induced hyperglycemia. Journal of Diabetes 6 (2014) 9-20

Management of hyperglycemia in COVID-19 patients



Glycemic targets in COVID-19 cases

- In general, the goals of treatment are the same as in other hospitalized patients.
- A blood glucose target of 140 to 180 mg/dL is reasonable for most critically ill and noncritically ill hospitalized patients.
- Many patients (even without dexamethasone) have severe insulin resistance and require high doses of insulin to achieve these goals.

Type 2 diabetes (eating a normal diet)

- Some patients with type 2 diabetes and <u>mild to moderate</u> COVID-19 <u>without dexamethasone therapy</u> may be able to continue part of their outpatient regimen if glucose is wellcontrolled and no contraindications are present.
- However, SGLT2 inhibitors and medications that cause nausea or vomiting (eg, GLP-1 receptor agonists) and, in some cases, metformin, should be discontinued.
- If glucose levels are poorly controlled (eg, persistently >200 mg/dL) or <u>if dexamethasone is initiated</u>, discontinue oral agents and begin basal (and prandial) insulin. If the patient is already on home basal prandial insulin regimen, increase insulin doses (by 30-40% and adjust by 10-20% daily)



Type 1 diabetes (eating a normal diet)

- Most patients <u>mild to moderate</u> COVID-19 <u>without</u> <u>dexamethasone therapy</u> should continue their outpatient regimen at same doses, if glucose was well controlled.
- If dexamethasone is initiated, increase insulin doses. (by 20-30% and adjust by 10-20% daily)



Diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar state (HHS) in COVID-19 cases

 Subcutaneous insulin protocols (rather than intravenous insulin infusions) are being used with increasing frequency to treat mild to moderate DKA or HHS during the COVID-19 pandemic, when intravenous insulin may not be practical owing to the need to limit frequency of contact of staff with patients. In this setting, dosing and monitoring are being performed every two to four hours.

The diagnostic criteria proposed by the American Diabetes Association (ADA) for mild, moderate, and severe DKA and HHS

Гурical laboratory characteristics of DKA and HHS*					
		DKA			
	Mild	Moderate	Severe	iiiis	
Plasma glucose (mg/dL)	>250	>250	>250	>600	
Plasma glucose (mmol/L)	>13.9	>13.9	>13.9	>33.3	
Arterial pH	7.25 to 7.30	7.00 to 7.24	<7.00	>7.30	
Serum bicarbonate (mEq/L)	15 to 18	10 to <15	<10	>18	
Urine ketones [¶]	Positive	Positive	Positive	Small	
Serum ketones - Nitroprusside reaction	Positive	Positive	Positive	≤ Small	
Serum ketones - Enzymatic assay of beta hydroxybutyrate (normal range <0.6 mmol/L)^ $\!\!\!\!^{\Delta}$	3 to 4 mmol/L	4 to 8 mmol/L	>8 mmol/L	<0.6 mmol/L	
Effective serum osmolality (mOsm/kg) $^{\Diamond}$	Variable	Variable	Variable	>320	
Anion gap [§]	>10	>12	>12	Variable	
Alteration in sensoria or mental obtundation	Alert	Alert/drowsy	Stupor/coma	Stupor/coma	

American Diabetes Association. From Diabetes Care Vol 29, Issue 12, 2006. Information updated from Kitabchi AE, Umpierrez GE, Miles JM, Fisher JN. Hyperglycemic crises in adult patients with diabetes. Diabetes Care 2009; 32:1335



Subcutaneous protocols for DKA in patients with COVID-19

https://professional.diabetes.org/content-page/inpatient-insulin-protocols-covid-19

Subcutaneous insulin for diabetic ketoacidosis (DKA):

<u>Montefiore subcutaneous insulin DKA protocol</u> <u>University of Washington Subcutaneous Insulin DKA Protocol</u> <u>Mount Sinai Hospital Emergency Room Guidance</u>



Mount Sinai Hospital Emergency Room Guidance https://professional.diabetes.org/sites/professional.diabetes.org/files/media/dka_guidelines_for_covid.pdf

COVID DKA	Initiation	FS >250 Check q3h	FS <250 Check q3h	Transition: Gap<12, HCO3>18, pH >7.3
Fluids*	NSS: 500mL in first hour	NSS: 125mL/hr for 1L. Reassess fluid status and continue prn.	Start D5 ½ NS or D10. Titrate for glucose and fluids status.	Hold dextrose fluids
IV Insulin protocol (pH < 7.0, HCO3 < 10, pregnant)	-Glargine 0.1units/kg SQ. -Reg insulin IV gtt: Bolus 0.1 units/kg + 0.1units/kg/hr	Titrate: ΔGlc <50: ↑gtt 20%. ΔGlc 50-75: No Δ ΔGlc >75: ↓gtt 20%	Titrate: ↑Glc >50: ↑gtt 20%. ↓Glc >50: ↓gtt 20%. Stable: No Δ	<20 hrs since glargine: order glargine 0.1 units/kg; >20 hrs: glargine 0.2 units/kg. Stop gtt 1hr later. Prandial lispro. [‡]
		Consider transition to and pH>7.2, bicarb>1 Overlap gtt and lis	o SQ regimen if needed L4 but gap is still open. spro by 30 minutes	
SQ Insulin protocol**	Glargine 0.2 units/kg. Lispro 0.2 units/kg	ΔGlucose <75, lispro 0.2 units/kg q3h. ΔGlucose >75, lispro 0.1units/kg q3h	2 Lispro 0.1 units/kg q3h	Continue glargine 0.2units/kg q24h. Prandial lispro [‡]
Electrolytes: Check BMP, M Ph , VBG q4-6	g, h	old insulin until >3.3. 3.3-4 Mg replete if <1.5. Ph re	I: Add 40 mEq KCl/L IVF. 4.1 plete if <1. Na : correct for h	-5: Add 20 mEq KCl/L IVF. yperglycemia.
*Non-COVID: Doubl	e fluids. ** ESRD: Half S	SQ doses. ‡ Prandial lispro	o=glargine dose/3. If on ster	oids, increase SQ doses by 50%

Dexamethasone + COVID-19

Symposium Management of Hyperglycemia in COVID-19 Patients on Dexamethasone

Management of steroid-induced hyperglycemia : in COVID-19 patients on dexamethasone

- For dexamethasone-induced hyperglycemia (without previous history of DM),
 - Start therapy if BG >200 (any BG) x 2 within 24 hours.
 - ? Sulfonylurea ± DPP4 inhibitor/metformin if mild hyperglycemia?
 - Moderate or severe hyperglycemia or uncontrolled on sulfonylurea, initiate NPH 10 U or 0.2-0.3 U/kg qam or 2 divided doses. Increase dose (especially am dose) by 10-20% daily (by 50% if BG >300) or initiate basal prandial insulin (30%-70% ratio)

Management of steroid-induced hyperglycemia in patients with diabetes: in COVID-19 patients on dexamethasone

- For known DM2 patients on OHA,
 - Start therapy if BG >200 (any BG) x 2 within 24 hours or poor DM control at home.
 - ? Sulfonylurea ± DPP4 inhibitor/metformin if mild hyperglycemia?
 - Moderate or severe hyperglycemia or uncontrolled on sulfonylurea, initiate NPH 20 U or 0.4 U/kg 2 divided doses. Increase dose (especially am dose) by 10-20% daily (by 50% if BG >300) or initiate basal prandial insulin (30%-70% ratio)

Management of steroid-induced hyperglycemia in patients with diabetes: in COVID-19 patients on dexamethasone

- For known DM2 or DM1 patients on insulin,
 - On Basal insulin qhs >> Switch to am. And increase
 dose by 10-20% daily based on pre-dinner BG level
 - On 2 times daily insulin >> increase am dose by 10 20% daily based on pre-dinner BG level
 - On basal prandial insulin >> increase by 20-30% in DM1 and 30-40% in DM2 and then by 10-20% daily (30%-70% ratio)

Management of steroid-induced hyperglycemia in patients with diabetes: in COVID-19 patients on dexamethasone

- For <u>DKA/HHS</u>,
 - Mild to moderate DKA >>> SQ insulin protocol
 - Severe DKA >> usual care with insulin infusion

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December 12th, 2020. Saturday 9pm-1015pm Myanmar 630am-745am USA (California/PST)

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Additional resource for clinic-based physicians



Steroid-induced hyperglycemia: patient self-titration protocol

Currently on Insulin therapy:

[1] To calculate **10% of (pre-steroid) insulin dose** <u>for each</u> <u>injection</u> (eg, 10% of Lantus 50 U is 5U and 10% of Novolog 10 U is 1U)

[2] To add 10% of insulin dose <u>for each 10mg prednisone</u> (eg. add 60% additional insulin per dose if taking prednisone 60mg daily)

[3] To reduce 10% of (pre-steroid) insulin dose for every 10mg decrease in prednisone dose

NOTE: Basal insulin should be raised by 5% increment in most cases instead of 10% to avoid fasting hypoglycemia since steroid affects postmeal blood glucose level mainly.