



PROTOCOL FOR THE HYPERGLYCEMIA AND DIABETES MELLITUS IN HOSPITALIZATION

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CONCEPTS AND GLYCEMIC TARGETS

Hyperglycemia >140 mg/dl

HbA1c (Request at admission if not available in last 3 months):

- >6,5%: previous Diabetes Mellitus.
- 5,7-6,4%: prediabetes.
- <5,6%: hyperglycemia related with the hospitalization.

Hypoglycemia < 70 mg/dl (severe <40 mg/dl)

Objective critically ill patients: 140-180 mg/dl.

Objective non-critical patients: >100 mg/dl, fasting <140 mg/dl, postprandial <180mg/dl.

Glycemic controls:

- Before breakfast, lunch, dinner and 23 hours.
- In fasting every 6-8 hours.



SUBCUTANEOUS INSULINS TYPES

1. BASAL INSULINS (fasting glycemic control)

- ULTRA-LONG-ACTING (every 24h):
Glargine (Lantus®, Abasaglar®)
Detemir (Levemir®)
- INTERMEDIATE-ACTING (every 12 h)
NPH (Insulatard®, Humulina NPH®)
NPL (Humalog basal®)

2. BOLUS INSULINS (prandial glycemic control)

- ULTRA-SHORT-ACTING (2-4 h, inject prior eating)
Aspart (NovoRapid®)
Lispro (Humalog®)
Glulisine (Apidra®)
- SHORT-ACTING (6-8 h, inject 30min before eating)
Regular (Actrapid®, Humulina Regular®)

3. MIXTURES INSULINS (1ª cifra indica proporción de insulina bolus)

- Aspart + NPH (Novomix® 30,50,70)
- Lispro + NPL (Humalog Mix® 25,50)
- Rápida + NPH (Mixtard® 30, Humulina® 30:70)

4. DEVICES (Trade names are followed by the device name):



SUBCUTANEOUS INSULIN ALGORITHM (non-critical patient)

NO PREVIOUS INSULIN
Undiagnosed DM, diet +/-oral antidiabetic (ADOs)



REGULAR INSULIN REGIMEN
In breakfast, lunch and dinner
Every 6-8 h in fasting

BASAL-BOLUS-CORRECTION REGIMEN

1. BASAL/24H (Insulin glargine or detemir)
2. BOLUS BREAKFAST, LUNCH AND DINNER (aspart, lispro, glulisine)
3. CORRECTION BOLUS A,B,C (aspart, lispro, glulisine)

DOSE CALCULATION: (based in previous treatment)

- ADOs or no treatment: regular dose/24h, 50% basal y 50% in 3 bolus
- Basal+ADOs: = basal and 50% of this dose in 3 bolus
- Premezclas: total dose/24h, 50% basal and 50% in 3 bolus
- Basal-bolus: the same regimen

REGULAR INSULIN REGIMEN

GLYCEMIA (mg/dl)	UNITS (U)
<70	Hypoglycemia protocol
71-100	0
101-140	2
141-180	4
181-220	6
221-260	8
260-300	10
301-350	12
>351	15

CORRECTION BOLUS

GLYCEMIA (mg/dl)	A (<40U/day)	B (40-80U/day)	C (>80U/day)
< 70	Hypoglycemia protocol. Half dose after eating		
71-100	-1	-2	-4
101-140	Corresponding insulin		
141-180	+1	+1	+2
181-220	+2	+2	+4
221-260	+3	+4	+6
261-300	+4	+6	+8
301-350	+5	+8	+10
>351	+6	+10	+12

BOLUS-BASAL REGIMEN ADJUSTMENT

HYPERGLYCEMIA (>140 mg/dl without previous hypoglycemia)		HYPOGLYCEMIA (<70 mg/dl)	
Fasting	↑ 20% basal	Early morning	↓ 20% basal
Lunch	↑ 20% breakfast bolus	Morning	↓ 20% bolus desayuno
Dinner	↑ 20% lunch bolus	Afternoon	↓ 20% bolus comida
Before sleep	↑ 20% dinner bolus	Before sleep	↓ 20% bolus cena

HYPOGLYCEMIA MANAGEMENT (<70 mg/dl)

PATIENT CONSCIOUS AND ABLE TO INGEST	200 ml juice or 200ml water with 2 sugar packets	
PATIENT UNCONSCIOUS AND UNABLE TO INGEST	intravenous	10 g glucose iv
	without intravenous	Glucagon 1 mg (im o sc)

*Reevaluate glycemia in 15 min y repeat process if glycemia <70 mg/dl.
*Si If required repeat process 3 time o more:
-Patient conscious and able to ingest: 200ml of milk o yogurt and 2-4 biscuits.
-Patient unconscious and unable to ingest: Glucosaline 10% 500 ml iv in 6 hours.

FASTING MANAGEMENT

Fasting <24h (supplementary tests): Regular insulin o mixtures: half of dose.
Bolus/basal regimen: suspend bolus y maintain basal +correction.
Fasting >24h (surgery):
Suspend subcutaneous insulin and start FLUID-INSULIN REGIMEN iv/6h.

FLUID INSULIN REGIMEN

- Glucosaline 5% 500 ml iv with 10-20 mEq/K every 6h.
 - Include in first glucosaline dose of regular insulin according glycemia.
 - Capilar glycemia at each change of glucosaline.
- ADJUSTMENT :
- glycemia 121-180 or >181 and lowering >50: same dose
glycemia > 181 or lowering <50: +2u.
glycemia >251 or lowering <50: +4u.
glycemia >351 or loweing <50: +6u.

GLYCEMIA (mg/dl)	START INSULIN DOSE (U)	
	Previous dose: <60U/24h o unknown	Previous dose: >60U/24h
< 70	0 and hypoglycemia protocol	
71-100	0	4
101-140	2	6
141-180	4	8
181-220	6	10
221-260	8	12
261-300	10	14
301-350	12	16
>351	15	20

DIABETIC KETOACIDOSIS/HYPEROSMOLAR STATE

1. FLUIDS:

Start with 1000ml 0,9% saline iv in 1h. After 250-500ml/h saline iv 0,9% if low Na or hiposaline iv 0,3% if normal-Hight. Na. When glycemia <200 mg/dl glucosaline 5% 100-150cc/h.

2. INSULIN

0,1U/Kg regular insulin direct bolus. Insulina infusion iv start with patten 2.

3. POTASSIUM (check the renal function >50ml/h)

K < 3,3 mEq/L: 20 mEq K/500ml y low insulin infusion.
K 3,3-5,3 mEq/L: 10 mEq K/500ml.
K > 5,3mEq/L: not manage and control every 2h.

4. BICARBONATE (if pH<7.0)

Deficit calculation: (CO₃H normal -CO₃H patient) x weight x 0,5. Infuse half of calculate dose 1/6M in 4-6 h and reevaluate.

INSULIN INFUSION (Critical ill patient)

FLUID LINE:

Glucosaline 5% 60-100 mL/h ±1-2 mEq/Kg of ClK.

INSULIN LINE:

Saline 0,9% + 100U regular insulin in 100 ml (1U/ml)

START:

Pattern 1.
(Pattern 2 if >80U/día, high dose of glucocorticoids, diabetic ketoacidosis diabética/hyperosmolar state)

CAPILAR GLYCEMIAS:

Every hour to target 140-180 mg/dl, afters every 2-4 h.

ADJUSTMENT:

Same pattern: glycemia 140-180 or >180 with lowering >50.
Top pattern: glycemia >180 or lowering <50.
Lower pattern: glycemia <140.

TRANSITION TO SUBCUTANEOUS INSULIN

DOSE CALCULATE: insulin last 6h x4.

DISTRIBUTION: basal-bolus regimen (50% basal - 50% bolus).

OVERLAP: mantain infusion 3 h after administer basal

GLYCEMIA (mg/dl)	PATTERNS INSULINA INFUSION (U/h)			
	Pattern 1	Pattern 2	Pattern 3	Pattern 4
< 70	HYPOGLUCEMIA PROTOCOL and stop 1h the infusion			
71-140	0	0	0	0
141-180	1	1	2	2
181-220	1	2	3	4
221-260	2	4	6	8
261-300	3	5	7	10
301-350	4	6	8	12
>351	5	7	10	15

SPECIALS SITUATIONS

HbA1c<8%: Restart pretreatment

DM unknown or HbA1c>8%: Initiate or intensify treatment (Consult ENDOCRINOLOGY UNIT)

PERFORMANCE AT HOSPITAL DISCHARGE

DM1, PUMP, Pregnancing DM, DM, Parenteral nutrition, altas dosis de insulina, DM inestable, etc (Consult ENDOCRINOLOGY UNIT)

MAIN REFERENCES

1. Tratamiento de la hiperglucemia en el hospital. Pérez A. et Al. Endocrinol Nutr. 2009;56(6):303-16.
2. Diabetes care in the hospital, nursing home, and skilled nursing facility. Diabetes Care 2015;38(1) S80-S85.
3. Protocolo de Insulinización Hospitalaria. Sociedad Andaluza de Endocrinología y Nutrición.
4. Protocolo de Manejo Hospitalario de la Diabetes. Hospital de la Princesa (Madrid)

