Review Article

Indoor management of diabetes

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Hyperglycemia in indoor patients is defined as any blood glucose >140 mg/dl 1 and are further classified as: hyperglycemia in previously diagnosed/known diabetes; previously undiagnosed diabetes/diagnosed upon admission. Hyperglycemia is most common in critically ill patients especially stress hyperglycemia. It is recommended to start intensive intravenous insulin therapy with short-acting regular human insulin or rapid acting insulin analog, preferably using an infusion pump in critically ill. Basal bolus is the preferred regimen and if well controlled on pre-mixed insulin in non critically ill. The discharge plan in diabetes should begin well before the discharge to ensure smooth transition of care between hospital and home. Those on insulin should be educated for insulin injection rotation technique, site rotation, frequency of self-monitoring of blood glucose, insulin dosage adjustments to achieve glycemic targets and hypoglycemia management. There are no pre-requisites for perioperatively. A stable glycemic control prior to the elective procedure with HbA1c target of <8% (corresponding to mean plasma glucose of 180 mg/dl) is acceptable. Maintenance of target blood glucose levels during labour and delivery requires a balanced administration of insulin and glucose preferably in the form of separate infusions.

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Key words **: Indoor hospital management, insulin, glycemic control.**

Hyperglycemia in indoor patients is defined as any blood glucose >140 mg/dl[1] and are further classified as[2]: hyperglycemia in previously diagnosed/known diabetes; previously undiagnosed diabetes/diagnosed upon admission (FPG >126 mg/dl or random blood glucose RBS >200 mg/dl) occurring during hospitalization and confirmed as diabetes after hospitalization by standard diagnostic criteria and stress hyperglycemia (fasting PG >126 mg/dl or random BG >200 mg/dl occurring during the hospitalization that reverts to normal after hospital discharge.

Critically Ill Patients :

Hyperglycemia is most common in critically ill patients especially stress hyperglycemia. Such patients have worse clinical outcome compared to those with pre-existing diabetes with a comparable degree of hyperglycemia.

Glycemic goals for indoor management of diabetes in critically ill patients[2] are as follows:

- Keep initial target of 80-110 mg/dL (4.4-6.1 mmol/L).
- Start insulin therapy for persistent hyperglycemia >180 mg/dL (10.0 mmol/L).
- Once insulin therapy is started keep glucose target of 140-180 mg/dL (7.8-10.0 mmol/L)
- More strict goals as 110-140 mg/dL (6.1-7.8 mmol/L) are kept for selected patients.
- It is recommended to start intensive intravenous insulin therapy with short-acting regular human insulin or rapid acting insulin analog, preferably using an infusion pump in critically ill.
- The insulin infusion (U/L) is calculated by dividing the blood glucose value in (mg/dL) by 100 and rounding it off to the nearest decimal eg. If blood glucose value is 237 mg/dL, then start insulin infusion at a rate of 2 units/ hour and titrate intravenous insulin dosage according to capillary blood glucose level measured every hour.
- If blood glucose <70 mg/dL stop insulin infusion and treat hypoglycemia by monitoring blood glucose every 20-30 minutes till hypoglycemia improves.
- Subcutaneous administration of insulin is avoided in critically ill patients because of its unreliable absorption in patients with peripheral oedema, hypotension, or shock and stacking of insulin effect causing delayed hypoglycaemia.
- Transition to subcutaneous insulin therapy (basal bolus regimen) is recommended once the patient is stable and on enteral/ oral feeds and should be started at least 1 hour prior to discontinuing intravenous insulin therapy.
- Abrupt discontinuation of IV insulin often leads to rebound hyperglycemia. Hence, the transition orders from

- **Stress hyperglycemia common in critically ill.**
- **Short or rapid acting IV insulin is preferred.**
- **Basal bolus in non critically ill.**
- **Patient's education for insulin use.**
- **Discharge is planned well before the discharge.**

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IV to SC insulin should be made carefully and only after patient exhibits good glycemic control.

• Transition is successful if blood glucose levels range from 140 and 180mg/dl with an insulin drip rate of <2units/h. Total insulin dose (TDD) is calculated by finding a time interval of several hours (ideally, 4-6-h duration), during which the blood glucose values are stable and at target. The insulin requirement during this stable period can be extrapolated to a 24-h time period.

• For patients who are on liquid diet the basal insulin are given (e.g. glargine, detemir) or two doses of intermediate-acting insulin (NPH) every 12 h. Correctional short-acting insulin (regular) or rapid-acting insulin (eg, aspart, glulisine, lispro) are added depending on nutritional intake and glucose levels[3].

• For patients who are on oral intake, 50% of the calculated dose of insulin is given as basal dose and the rest is divided evenly between the three meals as the bolus dose.

Non Critically Ill :

• The targets for the majority of non-critically ill patients are pre-meal BG<140mg/dl and post-meal BG<180mg/dl.4 Basal bolus is the preferred regimen and if well controlled on pre-mixed insulin, they can be continued on the same regimen.

• TDD of insulin can be calculated from the insulin requirement in previous 6h of stable control of BG and multiplied by 4 to get the TDD in 24 h.

• In non-critically patients who are NPO or unable to eat, bolus insulin must be withheld until nutrition is resumed. But correction insulin can be continued to treat BG above the desired range.

• Sliding Scale Insulin (SSI) (defined as the administration of a pre-established amount of short-acting insulin in response to hyperglycemia) as the sole regimen for the indoor management of hyperglycemia is ineffective and therefore, not recommended.

• The use of oral antihyperglycemic agents and other non-insulin therapies are challenging indoor hospital management because there are frequent contraindications to their use in many inpatient situations (sepsis, NPO status, IV contrast dye, pancreatic disorders, renal failure, etc)

• Selected patients can continue previously prescribed oral anti-hyperglycemic agents (AHA) therapy in the hospital, those who are clinically stable and eating regular meals and who have no contraindications to the use of these agents.

Insulin Therapy at Discharge from Hospital :

• The discharge plan of a patient with diabetes should begin well before the discharge to ensure smooth transition of care between hospital and home.

• Different factors to incorporate into discharge plan include educational status, affordability, patient and family competence, psychological state, social and religious beliefs, co-morbidities and accessibility to health care.

• Those on insulin should be educated for insulin injection rotation technique, site rotation, frequency of self-monitoring of blood glucose, insulin dosage adjustments to achieve glycemic targets and hypoglycemia management.

• Patients must be encouraged to take their insulin themselves during hospital stay especially in those for whom insulin has been recently initiated.

• A follow-up appointment is scheduled within 15 days of discharge, with the medications summary.

• HbA1c levels of 8% should be cut-off to determine the future course of medications at discharge.

Perioperative Insulin Use :

• There are no pre-requisites for emergency life-saving procedures. A stable glycaemic control prior to the elective procedure with HbA1c target of <8% (corresponding to mean plasma glucose of 180 mg/dl) is acceptable.

• If the HbA1c is >9% or blood glucose >200 mg/dl and the surgery cannot be postponed, it is advised to first achieve blood glucose control prior to the procedure.

• On the day prior to procedure, patients can take full dose of anti-hyperglycemic medications including insulin at dinner. The patient will remain NPO till the procedure is complete in the morning and should take their usual dose of insulin and/or AHAs when they have breakfast by mid-morning.

• If the procedure is delayed unexpectedly and the blood glucose levels >180 mg/dl), GIK insulin infusion can be started or subcutaneous correction dose of short-acting insulin may be given followed by a close monitoring to avoid hypoglycemia.

• Metformin may not be discontinued for minor procedures unless there is renal, cardiac or hepatic impairment. It is discontinued 24 hour prior to procedure requiring IV radio-contrast administration and restarted after confirming normal renal function after 48 hr.

Insulin During Delivery :

• Insulin requirements significantly reduce during active labour due to reduced hepatic gluconeogenesis and increased calorie requirement.

• Uncontrolled maternal hyperglycemia during the labour can lead to fetal hyperinsulinism, consequently resulting in neonatal hypoglycemia.

• Feasible target levels of maternal blood glucose levels during delivery for prevention of neonatal hypoglycemia are 70-140 mg/dl.

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- Maintenance of target blood glucose levels during labour requires a balanced administration of insulin and glucose preferably in the form of separate infusions.4
- Depending on the glycaemic status, insulin infusion can be started at the rate of 0.5 to 1 units/h. Glucose containing fluid (in the form of 5% dextrose or dextrose normal saline (DNS) can be started to provide glucose at the rate of 80-125 ml/h.
- Glucose infusion can be started either simultaneously with insulin infusion or when blood glucose levels fall below 70 mg/dl. Where facility of infusion is not available, subcutaneous short acting insulin every 4-6 h may be given.
- A planned caesarean section should be posted early in the morning. Patient should take usual dose of nighttime insulin (short as well as intermediate or long acting) and OADs on the day prior to surgery.
- The morning dose of insulin as well as OADs should be withheld on the day of surgery, and blood glucose levels should be monitored closely.
- A similar protocol should be followed for induction of labour which again should be planned early in the morning. If the procedure is expected to get delayed (may take 8-12 h for induction of labour especially in primigravida) and a light breakfast is allowed by obstetrician, half the usual dose of insulin can be administered subcutaneously in the form of intermediate-acting insulin.
- Insulin and glucose infusions may be administered as required to maintain blood glucose levels between 70 and 140 mg/dl, if prolonged fasting is anticipated.
- In the post-partum period, blood glucose levels may normalise in patients with gestational diabetes while the insulin requirement may drastically come down for patients with type 1 and type 2 diabetes.

References

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