Management of diabetes mellitus in surgery: A simple & safe protocol

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Abstract
Surgical stress stimulates counter regulatory hormone secretion, which decreases insulin sensitivity and inhibits insulin release. These changes favour catabolism, which can rapidly cause hyperglycaemia and ketosis in insulin deficient diabetic patients. Other potential hazards of surgery in diabetic patients include hypoglycaemia. Successful management of surgery in diabetic patients requires simple and safe protocols which are fully understood by all staff. A safe and practicable target range for blood glucose levels during the perioperative period is 6-11 mmol/l.

Introduction
Managing diabetes in people undergoing surgery is a common problem. Diabetic patients occupy 9% or more of general hospital beds, and several chronic complications- including peripheral vascular disease, foot problems, advanced vitreoretinal disease, terminal renal failure and severe oro-dental problems may require surgical intervention. Diabetic control is often suboptimal in patients undergoing routine surgery, unfortunately, responsibility for this is all too often delegated to the junior members of the surgical team and they are more likely to be familiar with modern diabetes management. The purpose of this article is to demystify this topic by providing simple, safe and effective guidelines for diabetic management that can be easily used on a busy surgical ward.

Hazards
Surgery in diabetic persons has associations with increased risk of per-operative complications compared to that in non-diabetic persons. This is due to involvement of their vital organs including the autonomic nervous system in the natural course of the disease.

The diabetic person undergoing surgery faces four (4) potential hazards in addition to the operation's usual risks in the non-diabetic population. These are-

1. Hyperglycaemia and ketosis: Due to the metabolic responses to the stress of surgery, especially in patients with inadequate insulin levels.

2. Hypoglycaemia: Due to perioperative fasting, sometimes exacerbated by the delayed effects of long-acting insulins or oral hypoglycaemic agents (e.g. chlorpropamide or glibenclamide) given preoperatively. This is a major hazard that must be strenuously avoided, as the anaesthetized or sedated patient may be unaware of hypoglycaemia or unable to communicate.

3. Perioperative complications: That are increased by diabetes, specially wound infections and myocardial infarction.

4. Iatrogenic problems of diabetic control: Usually due to poor or neglected management protocols, inadequate glucose monitoring and failure to correct obvious abnormalities.

Some key points
· Poor metabolic control results in dangerous acute metabolic complications due to surgical stress.
· The infection if develops, tends to become virulent which further worsens the metabolic state, thus establishing a vicious cycle.
· Incase of non-insulin treated patients, long-acting sulphonylureas should be replaced by shorter-acting agents some days before surgery, to reduce the risk of hypoglycaemia. Most well-controlled patients undergoing minor surgery only require close glycaemic monitoring during perioperative

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period. Those who are poorly controlled, or who are to undergo major surgery, should be managed as for insulin treated diabetes.

- In case of insulin treated patients, continuous administration of both insulin and glucose is required during surgery. The combined delivery of insulin with glucose decreases the metabolic disturbances of surgery and may improve the outcome. Insulin and glucose can be given either through separate infusion levels, or mixed together with potassium to prevent hypokalaemia (the glucose-potassium-insulin regimen, or GKI).

- Separate-line-regimen-glucose (10% solution) is infused at 100ml/h, and the insulin delivery rate (usually 2-4 u/h) is titrated to maintain blood glucose (measured hourly) in the range 6-11 mmol/l.

- GKI regimen - An infusion of 500ml of 10% dextrose containing 15u soluble insulin and 10mmol potassium chloride is given intravenously at 100ml/h. A new infusion bag containing an appropriate insulin dosage should be substituted if hyper-or hypoglycaemia develop.

- Hyperglycaemia leads to impaired wound healing, deficient formation of granulation tissue, with poor tensile strength of collagen. The fibroblast formation takes longer time than non-diabetics and there is a deficient capillary growth into the wound. The chemotactic, phagocytic and bactericidal activity of the neutrophil is deficient. There is impaired humoral host defense mechanism and abnormal function.

- The great danger is hypoglycaemia, because of risk of brain damage (neuroglycaemia).

  - Normal plasma glucose level-
    - Fasting blood sugar should be less than 6.4mmol/l.
    - 2 hours after breakfast or meal should be less than 7.8mmol/l.
    - 2 hours after taking 75g anhydrous glucose should be less than 11.1mmol/l.
    - Random blood glucose should be less than 10mmol/l.

Checklist for planning surgery in diabetic patient

- Arrange date of operation.
- Liaise between anesthetists, surgeons & the diabetes team.
- Optimize glycaemic control.
- Ancillary investigations - ECG, chest radiograph, renal function & electrolytes.
- It should include assessment of any diabetic complication, or associated condition, which may increase surgical risk, e.g. cardiac autonomic neuropathy.

Factor need to be considered during planning surgery in diabetic individual

- Type of diabetes mellitus.
  - Treatment- diet, oral antidiabetic drugs, insulin.
  - Metabolic status.
  - Vascular status- cardiac, renal, cerebral.
  - Autonomic assessment.
  - Surgery-
    - Emergency or elective.
    - Minor or major procedure.
    - Type of anesthesia.
    - Post-operative oral intake.

Principles of management

Management of the individual patient is determined by the severity and nature of the surgical trauma, the duration of the peri-operative fasting, the pre-existing diabetes treatment and the capacity of the patients insulin reserves. Type 1 diabetic patients effectively have no endogenous insulin and will therefore require exogenous insulin, and the same must be assumed for insulin treated subjects with type 2 diabetes. By contrast, subjects who are usually managed successfully without insulin can be considered to have at least some residual b-cell function. They need insulin treatment only for major surgery; otherwise, simple observation is generally sufficient. ‘Safety and simplicity’ are the watchwords for the surgical management of diabetic patients.
Protocols for managing surgery in diabetic patients who are not treated with insulin

1. Ensure satisfactory preoperative control. Operate in the morning if possible.
2. Liaise with the anesthetist.
3. The patient should omit breakfast, and insulin or oral antidiabetic drug, on the morning of surgery.
4. Non-insulin-treated diabetic patients, having non-major surgery, need observation only. 2 hourly glucose reagent strips on the day of surgery. Patients taking oral antidiabetic drugs can restart these with next meal.
5. ‘GKI’ is used in all other cases, i.e.: (a) All insulin-treated diabetic patients; and (b) Major surgery in non-insulin-treated diabetic patients.

Special surgical situations (Emergency surgery)

- Hospitalize the patient.
- Diabetic patients who need urgent rather than elective surgery must be fully assessed clinically & biochemically, because the problem necessitating surgery may have led to metabolic decompensation, this should first be corrected if possible.
- Start normal saline drip with 12-16 units of soluble insulin depending on the blood glucose levels, drip to be given at the rate of 4-6 units per hour.
- Check electrolytes, acid base & ketone levels.
- Try to avoid surgery till blood glucose goes below 20mmol/l & absence of ketonuria.
- If not possible, allow operation, with intensive management of diabetic state in conjunction with the surgical procedure.
- Patient may require normal saline-insulin drip till blood glucose levels drop to acceptable range.
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- Serum electrolytes and acid base balance require close monitoring.
- Ensure adequate hydration.
- Further management as per general principles.

Conclusion
The therapeutic goals during surgery in diabetic patients are to minimize fluid and electrolyte losses secondary to osmotic diuresis by limiting hyperglycaemia, to prevent diabetic ketosis in type I patients, and to avoid hypoglycaemia while patients are anesthetized. The aim should be to have optimal control of diabetes in all diabetics undergoing surgery. It is important to emphasize that with optimal care, surgery in a diabetic is as safe as in a person without diabetes.

References