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Anesthetic Management of Patient with Diabetes Mellitus

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Abstract: ***The prevalence of diabetes mellitus is steadily increasing throughout the world and in India; the prevalence of diabetes varies from 15% to 20% of the adult population. The age of onset of diabetes is also coming down in India. Inevitably, more and more number of diabetic patients require surgery and hence anesthesia. Perioperative glycemic control and end-organ effects of diabetes influence the surgical outcome and prognosis of the patient. By proper pre-anesthetic evaluation and risk assessment, good anesthetic techniques, meticulous glycemic control and efficient postoperative management, anesthesia can be made safe in diabetic patients. Perioperative management of diabetic patients can be classified in to pre, intra and postoperative management. Due to the rising prevalence of diabetes, the provision of safe anaesthesia for these patients will become increasingly important. Type 1 diabetes always requires the administration of insulin and type 2 patients undergoing moderate or major surgery will require conversion to an insulin regimen during the perioperative period.***

Keywords: anesthesia, diabetes mellitus, glycemic control, surgery

1. Introduction

Patients with diabetes have a higher incidence of morbidity and mortality following surgery and have an increased length of stay in hospital.[1] However, diabetes is often managed in an ad-hoc fashion by those with limited expertise in this area.

Diabetic patients who require surgery present special challenges in perioperative management. Special attention must be paid to prevention and treatment of metabolic derangements. Vigilance for the development of acute complications that lead to higher rates of surgical morbidity and mortality is also critical.

2. Perioperative Response to Surgery and Anesthesia

Surgery and anesthesia invoke a neuroendocrine stress response with release of counterregulatory hormones, [2] which results in peripheral insulin resistance, increased hepatic glucose production, impaired insulin secretion, and fat and protein breakdown, with potential hyperglycemia and even ketosis in some cases. The degree of this response depends on the complexity of the surgery and any postsurgical complications. In addition to counter-regulatory hormone excess and relative insulin deficiency, fasting and volume depletion contribute to metabolic decompensation.[3] Diabetic ketoacidosis occurs infrequently in patients with type 2 diabetes, but hyperglycemic hyperosmolar nonketotic states are well described. The latter are characterized by extreme hyperglycemia, hyperosmolarity, volume depletion, and associated changes in mental status resulting from inadequate insulin action, osmotic diuresis, fluid losses from surgery or overuse of diuretics, and volume under-replacement.[4] In patients with type 1 diabetes, diabetic ketoacidosis may develop in the absence of severe hyperglycemia because of inadequate insulin availability during a time of increased demand.

The high-risk surgical patient and the impact of diabetes

The high-risk surgical population is made up of elderly patients with co-existing medical conditions undergoing complex or major surgery, often as an emergency. The most important co-morbid diseases include ischaemic heart disease, heart failure, respiratory disease, impaired renal function and diabetes mellitus. There is clear evidence that such diseases are strongly associated with poor outcomes after major surgery[5-6].

3. Diabetes related patient factors associated with worse outcomes

Poor peri-operative glycaemia control.

Glycaemic control has a significant impact on the risk of post-operative infection across a variety of surgical specialities[7]. Post-operative glycaemic control significantly influences the healing of deep sternal wound infection after open heart surgery and has been shown to have a similar on impact on healing in other forms of surgery[7]. The 2009 National Inpatient Diabetes Survey found that 25% of patients on surgical wards experienced a hypoglycaemic event and inpatient hypoglycaemia is associated with increased mortality. Diabetic ketoacidosis, though completely avoidable, still occurs on surgical wards and can result in postoperative death[8].

Complications of diabetes

Diabetes is associated with a two to four fold increase in cardiovascular disease including hypertension, coronary artery disease and stroke[9]. The majority of people with diabetes booked for surgery are likely to have one or more of these cardiovascular diseases and a significant number will have microvascular disease. Those with impaired cardiac function and/or nephropathy are at greater risk of fluid overload. Post-operative cardiac arrhythmias are more common in people with diabetes, particularly in those with autonomic dysfunction or a prolonged QTc interval[10]. The incidence of postoperative hypotension is increased, related to a combination of autonomic dysfunction, inadequate fluid replacement and inadequate monitoring of hypotensive

therapies. This can precipitate renal failure in those with nephropathy and hypotensive falls in the elderly. Neuropathy affects between 30-50% of people with diabetes and places them at increased risk of heel ulceration, particularly if peripheral vascular disease is also present[11].

Current evidence suggests that doctors often fail to identify high-risk patients before surgery and do not ensure that appropriate peri-operative interventions are provided.

Glycemic Control

Establishing good glycemic control and correcting any other metabolic abnormalities are usually accomplished on an outpatient basis before surgery because most patients are hospitalized just before surgery. To stabilize glycemic control in patients taking insulin, frequent glucose monitoring should be performed, with insulin dosages adjusted appropriately. Ideally, patients should monitor blood glucose levels before meals, after meals, and at bedtime. Long-acting insulin can be discontinued one to two days before surgery, and glucose levels can be stabilized with a regimen of intermediate insulin mixed with short-acting insulin twice daily or short-acting insulin before every meal.

4. Evaluation For Emergency Surgery

Many patients with diabetes who require emergency surgery will not be in good meta-bolic control at that time and may even have diabetic ketoacidosis. The first priority is to assess glycemic, acid-base, electrolyte, and fluid status, and correct any derangements before surgery. This step is especially critical if acidosis or potassium abnormalities are present. Surgery should be delayed, if possible, to stabilize metabolic status.

Intraoperative Management

The aim of intraoperative management is to provide adequate anesthesia, proper positioning and to avoid hypoglycemia, hyperglycemia, ketoacidosis and electrolyte disturbances. It is important to time diabetic patients as first in the operating list, thus shortening the starvation period. Positioning of the patient is also very important to avoid pressure sores and it should be done gradually to avoid sudden drop in blood pressure. Careful titration of inducing agents should be done with adequate preloading to avoid hypotension due to autonomic neuropathy. There are no contraindications to standard anesthetic induction or inhalational agents. Rapid induction with cricoid pressure should be done if gastroparesis is suspected. A nasogastric tube can be positioned and aspiration should be done if required. Anticipate difficulty in intubation and back up of laryngeal mask airway, proper blades and endotracheal tubes, tracheostomy facility and expert help should be ensured. Intravenous induction agents may cause hypotension, which is worsened in diabetic patients with autonomic neuropathy. Adequate preloading, reducing the dose of induction agents and slow injection will reduce hypotension.

All patients with type 1 diabetes and many with type 2 diabetes require insulin intraoperatively to maintain glycemic control. Patients with type 2 diabetes who are chronically treated with only diet or small doses of oral agents and who are in good control before surgery may not require insulin if the surgery is relatively short. In many situations, including chronic poor control or complicated surgical procedures, patients with type 2 diabetes benefit from insulin treatment to maintain glycemic control. The best method of providing insulin during surgery is debatable. Few data clearly demonstrate the superiority of one regimen over another. Any regimen should (1) maintain good glycemic control to avoid hyperglycemia and hypoglycemia; (2) prevent other metabolic disturbances; (3) be relatively easy to understand; and (4) be applicable to a variety of situations. The key to success of any regimen is careful, frequent monitoring to detect any alterations in metabolic control and correct them before they become severe.[12]

Dehydration should be avoided; normal saline can be used as maintenance fluid. Dextrose containing fluids and ringer lactate are better avoided. Blood sugar should be maintained with insulin-glucose infusion as explained above. Blood sugar should be monitored every hour, also as in any other case SpO2, blood pressure, ECG, end tidal carbon dioxide, urine output and temperature should be monitored. Continuous arterial blood pressure should be monitored if the patient is hemodynamically unstable or large fluid shifts are anticipated. Five lead ECG is indicated if the patient has evidence of myocardial ischemia.

5. Postoperative Management

During postoperative period, insulin-glucose infusion should be continued till at least 2 hours after the first meal. Blood sugar should be monitored every 2 hourly and normal insulin regime or oral hypoglycemic agents can be started with the first meal. It is also important to monitor the sodium and potassium levels. Postoperative hyponatremia is a common electrolyte abnormality and hypokalemia if not answered at the right time may lead to cardiac arrhythmias. Nausea and vomiting should be prevented, and if present, should be treated vigorously. Good analgesia decreases catabolic hormone secretion. Nonsteroidal anti-inflammatory drugs should be used with caution in patients with renal dysfunction. Judicious use of antibiotics and better wound care and postoperative glycemic control can prevent postoperative infection.[13,14]

Diabetic patients may require surgery as a consequence of their disease process or otherwise. Giving anesthesia to diabetic patients is usually not associated with any additional risk if proper care is taken during pre-anesthetic check-up. Meticulous glycemic control prior to surgery is required; if possible, HbA1c should be brought to normal before any planned surgery.

6. Special Situations

It is not practical to admit diabetic patients several days before surgery to stabilize their antihyperglycaemic medication. Even for major procedures, admission on the day of surgery is common and, fortunately, seems safe. More operations are now done on a day-case basis and there is no evidence to support blanket exclusion of diabetic patients from day surgery. Diabetics attending day surgical

centres for minor procedures should have oral intake and absorption re-established before discharge, normal medication resumed as soon as possible and adequate glycaemic monitoring available on discharge.

7. Conclusion

Due to the rising prevalence of diabetes, the provision of safe anaesthesia for these patients will become increasingly important. Type 1 diabetes always requires the administration of insulin and type 2 patients undergoing moderate or major surgery will require conversion to an insulin regimen during the perioperative period. Good glycaemic control is associated with a decreased risk of infection and therefore blood glucose is usually maintained at < 10 mmol.l)1. However, the ideal range of blood glucose in the perioperative period has only been established in cardiac surgical patients. Continuous insulin infusions have been shown to provide better glycaemic control than intermittent regimens and combined glucose-insulinpotassium regimens have the advantage of inherent safety.

8. Conflict of interest

None declared.

9. Sources of Funding

Nil.

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