Editorial

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Diabeto-anaesthesia: A subspecialty needing endocrine introspection

The advent of mechanical ventilators was a boon for anaesthesia and intensive care in the 1950s. These ventilators revolutionised modern-day anaesthesia and intensive care practices, thus contributing hugely to decreased anaesthesia-related morbidity and mortality.[1] No single discovery since then has contributed so much to improving the outcome of critically ill patients, until recently, when Van den Berghe used insulin to achieve tight glycaemic control in critically ill patients. Insulin usage was found to decrease both morbidity and mortality dramatically in critically ill diabetic patients.[2] This discovery spurred interest regarding diabetes amongst anaesthetists.

Diabetes mellitus (DM), the common endocrinopathy worldwide, affects over 371 million people, one-sixth of the population in India.[3] Data from developing nations are scarce, but available evidence indicates that every 5th or 6th patient admitted to intensive care unit (ICU) has diabetes.[4] These statistics may be an underestimate of the actual prevalence as DM is widely underreported and remains undiagnosed in many parts of India. Many of these cases are diagnosed only when they seek help for a surgical or medical pathology.

The increasing prevalence of diabetes in society definitely has a significant impact on anaesthesiology and ICU practices. The control of hyperglycaemia is an important determinant of outcome in surgical and critically ill patients. Various prophylactic and therapeutic strategies have been developed to achieve and maintain euglycaemia in critical care and anaesthetic settings. Such interventions include, but are not limited to usage of insulin in hyperkalaemia and in parenteral nutrition besides its utility in numerous clinical situations in anaesthesia and intensive care. A general lack of awareness has been observed, however, among peri-operative physicians with regards to various management strategies for hyperglycaemia. This can partly be attributed to non-availability of universal guidelines, written by anaesthetists, or for anaesthetists, to manage peri-operative hyperglycaemia. Guidelines set by international organisations of endocrinologists and diabetologists (American Association of Clinical Endocrinologists and American Diabetes Association) may be difficult to implement in resource-challenged clinical settings, and are not well known in anaesthesia or intensive care teams, which manage the bulk of indoor diabetes in the country.[5]

There is an increasing need to develop the subspecialty of "endocrine anaesthesia," including "diabeto-anaesthesia" so as to introduce newer therapeutic strategies and implement appropriate guidelines for endocrine morbidity encountered by the practicing anaesthesiologist. This aspect of anaesthesia can be taken to newer heights in coming years with active collaboration of endocrinologists, anaesthesiologists, and intensivists. This editorial focusses on the multifaceted links of DM and anaesthesia [Table 1].

PRE-OPERATIVE EVALUATION

The challenge for the anaesthesiologist begins during pre-anaesthetic check-up (PAC) as DM can have diverse clinical presentations. Patients may or may not be aware of their diabetes, may or may not be on medication, and can present with controlled or uncontrolled hyperglycaemic status. Quite a few individuals are diagnosed with diabetes, while ordering investigations to assess fitness for anaesthesia and surgery.

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Table 1: Significant association of DM and anaesthesia

Diabeto-anaesthesia framework
Impact of diabetes on anaesthesia
On PAC
History
Examination
Management
On choice of type of anaesthesia
On choice of drugs
Premedication
Analgesia
Anaesthesia
Supportive Rx
On postoperative care
Admission in ICU
Impact of anaesthesia/surgery on diabetes
Need for euglycaemia
Need for safer insulin analogues
Need for IV regular insulin/rapid-acting analogues
Avoidance of OHAs
Need for monitoring
Need for euvolaemia
Need for euelectrolytemia
Potential impact of anaesthesia on diabetology
On medical/paramedical colleagues
Continued medical education
Glucose monitoring policy
Glycaemic control policy
Best insulin injection practices

DM – Diabetes mellitus; PAC – Pre-anaesthetic check-up; ICU – Intensive care unit

A complete drug history and knowledge of current anti-diabetic medication can help in better management of hyperglycaemia during hospitalisation and surgery. Among the anti-diabetic drugs, metformin is commonly used, and of late, many of its contraindications have been relaxed. Pioglitazone can cause fluid overload and precipitate cardiac failure in high-risk patients. Currently insulin analogues are used in the management of DM. These pharmacological agents are considered to be safer than the conventional insulin regimens. While the rapid-acting analogues aspart and lispro insulins are compatible with all intravenous solutions, glulisine is compatible only with 5% dextrose. Premixed and long-acting insulins should not be administered intravenously.[6,7]

Pre-anaesthetic evaluation also focusses on anaesthetically significant co-morbidities such as acute, macrovascular and microvascular complications of diabetes. Higher morbidity and mortality results from end-organ damage rather than acute complications of DM. Cardiovascular diseases alone are responsible for 80% of overall death in diabetic patients.[8] Such patients may experience silent myocardial ischaemia during peri-operative period as a result of autonomic neuropathy which is prevalent in one-third of diabetics.[9,10] Autonomic neuropathy is a strong predictor of haemodynamic instability and silent myocardial ischaemia as had been observed in DIAD study (Detection of Ischemia in Asymptomatic Diabetics).[11] Incidence of cardiac arrhythmias and sudden peri-operative death is higher among patients with autonomic neuropathy which can be evaluated pre-operatively by simple bedside tests such as postural blood pressure changes and Valsalva manoeuvres.[9,10,12]

Literary evidence has suggested that diabetic patients undergoing elective surgeries have higher risk of myocardial ischaemia, renal ischaemia, cerebrovascular accidents, infections and delayed wound healing, as compared to non-diabetic patients.[13] Besides controlling the diabetes, co-morbid risk factors such as smoking, hypertension, renal insufficiency, hepatic derangement and hyperlipidaemia also have to be optimised before undertaking any elective surgery.[14] Such optimisation of medical status can minimise complications during elective surgery, but it may not be possible before life-threatening and emergency surgery.

Assessment for difficult airway in stiff joint syndrome, skin and soft tissue infections which may prevent intravenous access and genitourinary infections such as balanoposthitis which may make urinary catheterisation difficult are the other aspects of importance in PAC.

PRE-OPERATIVE MANAGEMENT: GLYCAEMIC PERSPECTIVE

Patients may present for either minor or major surgery which can be elective or an emergency life-saving procedure. For minor surgeries, hospitalisation should be done only in those diabetic patients with poor glycaemic control. Oral hypoglycaemics should be omitted on the day of surgery, while morning dose of insulin should be omitted in insulin-requiring DM patients. For prolonged and major surgeries, peri-operative intravenous insulin infusion is mandatory along with frequent blood glucose monitoring. All such surgeries should be performed as first case in the morning so as to prevent metabolic complications due to starvation and possible hypoglycaemia. The main aim during such major surgeries is the prevention of counterregulatory response, and various modern anaesthetic techniques and drugs are available to achieve this.

Peri-operative management of DM revolves around maintaining the "diabeto-anaesthetic triad": euglycaemia, euelectrolytemia and euvolaemia. Glucose, insulin and potassium (GIK) and variable rate insulin infusion are the most common methods to achieve these targets. Peri-operative administration of insulin should be carried out slowly in patients with diabetes and established autonomic neuropathy, as it can cause decrease in supine blood pressure and can also accentuate postural hypotension by decreasing systemic vascular resistance. These paradoxical effects are mediated by vasoconstrictive action at therapeutic doses and vasodilation effects at doses greater than therapeutic doses.[15]

PERI-OPERATIVE MANAGEMENT: MEDICAL PERSPECTIVE

Renal protection strategies are essential in DM patients as diabetic nephropathy can cause renal failure and insufficiency in patients with chronic renal disease.[16] Though considered protective, acetylcholine esterase (ACE) inhibitors should be avoided in patients with creatinine clearance <30 ml/min.[17] Metformin should also be avoided in such patients as decreased renal functions predispose the patient to lactic acidosis during peri-operative period.[18]

Gastroparesis resulting from autonomic neuropathy predisposes the patient to pulmonary aspiration during induction of anaesthesia.[10] The potential difficult airway in patients with stiff joint syndrome can be predicted to some extent by observing the stiffness of the fourth and fifth interphalangeal joints and "prayer" sign.[19]

Risk of hypothermia is also increased in patients with established autonomic neuropathy, particularly in prolonged and major surgeries as thermoregulatory mechanisms are affected to a varying degree.[20]

PERI-OPERATIVE MANAGEMENT: ANAESTHETIC PERSPECTIVE

Succinylcholine should be avoided in patients with diabetes and hyperkalaemia, while non-depolarising neuromuscular blocking agents should be selected on the basis of present hepatic and renal function sufficiency.[21] Midazolam given by intravenous infusion can decrease sympathetic activation and decrease serum adrenocorticotropic hormone (ACTH) and cortisol, but can increase growth hormone (GH) secretion. It may possibly suppress the hyperglycaemic response to surgery.[22] Opioids should be used cautiously as they may disturb metabolic, endocrine and haemodynamic milieu in patients with renal insufficiency. Fentanyl is preferred as the analgesic agent as compared to morphine in diabetes with renal compromise, as morphine-6-glucoronide, an active metabolite of morphine, is cleared by the kidney.[23]

The α-2 agonist drugs, dexmedetomidine and clonidine, have revolutionised anaesthesia and ICU practices in the recent years. These adjuvants help in attenuation of stress response by decreasing ACTH and cortisol secretion, thus preventing hyperglycaemia and maintaining haemodynamic stability, and have an anaesthesia-sparing effect when used in general and regional anaesthesia.[24,25] Though these agents may decrease insulin secretion during peri-operative period, hyperglycaemia is prevented overall by concomitant reduction of sympathetic activity.

Halogenated inhalational anaesthetic agents like halothane, isoflurane, enflurane and sevoflurane inhibit the release of insulin and can also cause negative ionotropic effect in diabetic patients.[26] Propofol should be used judiciously for sedation in ICU as prolonged stay of diabetics in ICU can cause reduced ability to metabolise lipids.[27] A significant increase in free fatty acids and a consequent decrease in triglyceride levels during exercise have been observed in patients administered heparin infusion. This can be possibly explained on the basis of increase in fat oxidation substrates and aerobic capacity that results in decreased glucose consumption and carbohydrate oxidation.[28] However, many more randomised prospective trials are needed to establish the protective effect of heparin on lipid metabolism in diabetic patients.

Till date, there is no published evidence to establish the safety of one anaesthetic technique over the other. Regional anaesthesia should always be preferred wherever feasible to avoid possible complications associated with general anaesthesia, such as difficult airway due to stiff joint syndrome. Regional anaesthesia has the advantages of decreased stress response, decreased blood loss, minimal risk of thromboembolism, and early resumption of oral intake and preservation of hypoglycaemia awareness. However, a few studies have raised concerns regarding higher incidence of infections and neurological injuries with neuraxial anaesthesia and concerns regarding cardiovascular instability have also been reported.[29]

POSTOPERATIVE CARE

Glycaemic control should extend into the postoperative period also. However, adequate analgesia is essential as pain can increase counterregulatory hormones, thus resulting in hyperglycaemia. Ideally, anti-emetic prophylaxis should be done during later part of the intraoperative period with administration of either long-acting 5HT3 antagonist palonosetron or ondensetron.[30] Various co-morbidities should be taken care of during the peri-operative and postoperative period. If necessary, such critical patients can be kept in high-dependency unit (HDU) or ICU.

Whether it is postoperative care or a primary admission into ICU, anaesthesiologists and intensivists frequently have to manage diabetes in ICU. Numerous studies have been carried out with regards to tight glycaemic control, but still a general consensus has not emerged with regards to tight glycaemic control in postoperative and critically ill patients. A major deterrent to tight glycaemic control is an increased incidence of hypoglycaemia which can worsen the outcome. Hypoglycaemia is difficult to recognise under anaesthesia as it may be confused with many clinical entities that mimic it. One can prevent hypoglycaemia by frequent glucose monitoring and by use of safer rapid-acting and long-acting insulin analogues (aspart, lispro, detemir).

Good glycaemic control during peri-operative period and in critically ill patients is associated with decreased morbidity and mortality and a better outcome. Diabetes care should be done meticulously for surgical and critically ill patients.

DELIVERY OF DIABETO-ANAESTHESIA SERVICES

Identification of a team leader in Operation Theatre and ICU is the key, and is mandatory for successful management of DM. The anaesthesia fraternity should update itself with current diagnostic, monitoring and therapeutic advances in the field of diabetes, so as to fulfill this role. Application of newer guidelines and current practices by the team leader encourages other medical staff to aim for achievement of the diabeto-anaesthetic triad, and establishes a good work culture.

There is a need to educate medical and non-medical personnel about the harmful effects of uncontrolled diabetes and its implications during peri-operative period. Staff, patients and their relatives must be sensitised regarding the need for blood glucose control, dietary control, appropriate physical activity if possible, intake of regular anti-diabetic medication and insulin injection techniques. Regular academic programmes and updates of existing staff can help in better dissemination of knowledge related to DM control and will help in upgradation of current practices, thus ensuring a better patient outcome. Patient education and motivation to control DM is also an important task before discharge from hospital. Patient education by an anaesthesiologist can also be possible to a large extent during regional anaesthesia in conscious (not sedated) patients, as during the peri-operative period, patients are highly focussed on their disease pathology and its related complications. Operation Theatre is perceived as a sacred place by majority of patients and as such all the teachings in such circumstances are more likely to be followed. Similar education and motivational conversations can be carried out during postoperative period at the time of discharge from the recovery room. This education will not only ensure better control and optimal outcome, but also go a long way in improving attitudes of society towards health care providers in general, and the men and women behind masks, in particular.

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