REVIEW ARTICLE

Anesthesia Management on Perioperative With Dm Patients: A Literature Review

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ABSTRACT

Diabetes Mellitus (DM) is a global burden. The aim of this work was to conduct a literature review that highlighted some of the most recent innovations based on the evidence foundation by identifying the standard textbooks in general. We utilized PubMed to search various databases, including Medline (January 2011 to June 2021), Google Scholar and Science Direct. Articles providing a decent methodological design were selected after the bibliographic survey. English seems to have its limitations. We found ten papers from France, Bangladesh, Portugal, the USA, as well as other countries that reflected our study material. The success of anesthetic management in DM patients was determined by managing pre-anesthesia blood glucose levels by setting a target for normal glucose levels and intensively monitoring glucose levels during and after surgery, which also determines the success of anesthetic management in DM patients. The predominance of postoperative complications requires thorough blood sugar monitoring during perioperative anesthesia to minimize the risk of hypo/hyperglycemia.

Keywords: Anesthesia management, Perioperative, Diabetes mellitus

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INTRODUCTION

Diabetes mellitus (DM) is a major comorbid condition that affects people throughout their lives. The global incidence of diabetes mellitus is rapidly increasing and has a detrimental impact on human existence; it is anticipated that, by 2025, the number of persons affected will have risen to almost 300 million. (1,2) Incidence of diabetes grew from roughly 1.7% in the 2000s to a highly changing estimate (4.4 %) in 2030. (3) DM affects 425 million adults over the age of 18 worldwide, according the International Diabetes Federation, with the incidence expected to rise by 35% by 2045 (1,4).

Perioperative care is often faced by patients with comorbidities such as DM, causing many systemic diseases that require surgical treatment that must be controlled properly and correctly (5). The risk of postoperative failure can occur at a higher level than non-diabetic patients. In addition, the incidence of hyperglycemia has negative consequences on all organ systems of the body (6). Perioperative hyperglycemia is reported in 20 to 40% of patients undergoing general surgery and the risk increases in about 80% of patients after cardiac surgery (1).

Olivera (7) found a prevalence of hyperglycemia with values of 180 mg/dl as high as 32% in both ICU and non-ICU patients in studies involving >3 million patients in >500 hospitals in the United States (7) .However, more than 30% of patients with postoperative fluctuating hyperglycemia, also known as situational stress hyperglycemia, had no prior history of diabetes (8).

On the other hand, the trend toward the risk of perioperative complications associated with diabetes mellitus is debatable, with perioperative mortality rates up to 50% higher than in the population (5). The problem of persistent hyperglycemia can lead to a variety of consequences, including cardiovascular disease, nephropathy, retinopathy, neuropathy, and a variety of lower extremity diseases, making glycemic control crucial in DM (5). This condition is often associated with poorly controlled medication side effects such as hyperglycemic failure, including comorbid micro and macrovascular complications, insulin prescribing errors, increased perioperative infection episodes associated with hypoglycemia and hyperglycemia, lack (or inadequate) protocols for managing inpatient diabetes and inadequate knowledge of diabetes and hyperglycemia management among staff providing care (2,9–12).

Moreover, perioperative anesthesia can result in acute perioperative problems including dehydration (osmotic diuresis), acidosis (increased lactate and ketones),

tiredness, and weight loss (lipolysis, protein catabolism) (12,13). Although there are several reviews that discuss how to treat patients with DM in the surgical field, it is still often confusing so that the consideration of assumptions and arguments in this situation needs to be developed and emphasized (14–16).

Due to the growing phenomena of methodological variety in both education and practice as nurse anesthetists, it is vital to explore this topic in order to provide solutions to these questions (17–19). Understanding the pathology of diabetes and the value of new studies could help diabetic surgical patients experience better perioperative care. This review will go over some of most recent developments in the field as well as how to handle diabetic patients perioperatively. This review will not provide a management algorithm.

METHOD

We searched several databases, including Medline via PubMed and Google Scholar (January 2011 to June 2021), the Cochrane Library, and Lilacs (from 2011 to June 2021). After the bibliographic survey, the articles with the better methodological design were selected. We also use evidence-based updates from the UpToDate and Medscape domains.

Google Scholar and ScienceDirect databases were searched using the terms Diabetes Milletus anesthesia surgery, Diabetes postoperative anesthesia, DM preoperative anesthesia, Diabetes perioperative management, Diabetes anesthesia management, and Diabetes anesthesia. The types of articles used in this work: reviews, systematic reviews, case reports, guidelines, and observational studies.

Searches were conducted between January 2011 and June 2021. The following strategies were used for searches in PubMed: ''Diabetes Mellitus'' AND ''Anesthesia'', ''Diabetes Mellitus'' AND ''Perioperative'', ''Glycemic Conditions Control'' AND ''Perioperative Care'', ''Glycemic Control'' AND ''Anesthesia'', ''Diabetes Mellitus'' AND ''Anesthesia'' AND; ''Diabetes Mellitus'' AND ''Anesthesia'', ''Diabetes Mellitus'' AND ''Perioperative'', ''Anesthesia''. To find studies on diabetes and perioperative care, a manual search was also conducted to locate unquoted papers in electronic journals and research references. The following are the requirements for inclusion: English-language studies, studies on the practice of glycemic control in adult diabetic patients who have surgery, independent of the type of operation were conducted. We also conducted a simple technique search because there were some articles that were not cited online in journals or bibliographies, and we added inclusion criteria such as studies on glycemic management in adult diabetes patients having surgery, independent of kind of operation, published in English. Recently published studies, regardless of whether there is no more recently published material, were included in order to reflect current therapeutic practice, because there are no evidence-based guidelines for the best perioperative care for diabetic individuals. Several management methods are discussed in this overview, based on what has been published internationally.

RESULTS

Of the 349 studies identified by our literature search, eight met the inclusion criteria; the screening diagram using PRISMA guidelines shows the process of searching and selecting the literature (Figure 1). It is important to consider that perioperative diabetes management is given to someone who is familiar with its complexities. In this study, it was found that two papers come from France (20) and the USA (8) which described several views of the perioperative management guideline for diabetes mellitus patients in general, while eight papers come from Bangladesh (21), Portugal (7), the UK (2), Georgia (4), Greece (9), and Brazil (5) which described the views of the basic concept on perioperative treatment in DM patients.

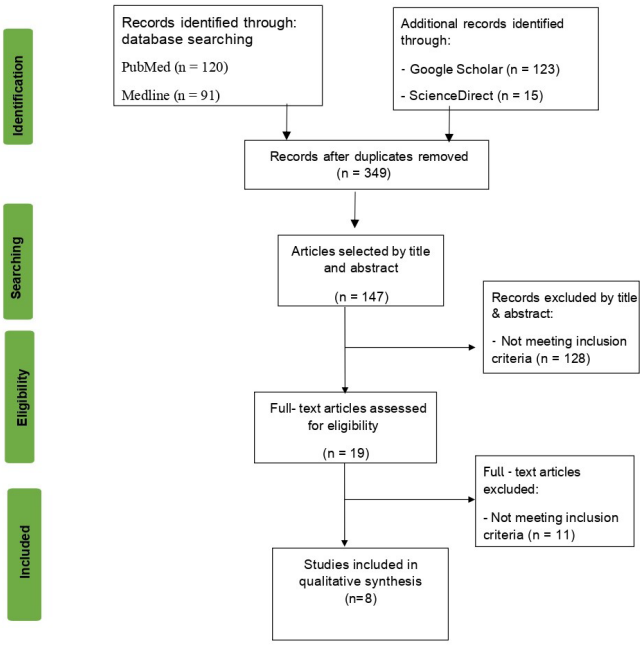

Figure 1: PRISMA flow diagram showing literature search results

Service standards for DM patients are needed in order to obtain effective management results, and can reduce the incidence of DM complications. Perioperative care requires a comprehensive collaboration from multidisciplinary aspects (anesthesiologists, nutritionists, surgeons, nurses, psychologists, etc.), so that the needs of each perioperative patient can be met properly (5,8,9,20). This recommendation does not describe all clinical situations in the field, nor is it intended to replace local policy protocols, and will require revision in future practice and can be used for considerations in making decisions (2,22–24).

DM is a set of symptoms induced by an increase in blood glucose (BG) levels as a result of a gradual decrease in insulin secretion, which can occur as a result of insulin resistance (5,6,10,25). According to the American Diabetes Association (ADA) (12) in 2019, DM is a collection of metabolic illnesses with distinctive hyperglycemia that arises owing to changes in insulin production, insulin action, or both (12,25). If a person has classic symptoms, including polyuria, polydipsia, and polyphagia, as well as a blood sugar level of 200 mg/dl and a fasting blood sugar of 126 mg/dl, they are diagnosed with diabetes (1,8,11,25–27).

DM Classification

Type 1 and type 2 diabetes mellitus are heterogeneous diseases because the clinical manifestations and course of the disease can vary (15,25,26). Determination of classification is very important to determine therapy, but there are some individuals who cannot be classified with certainty as to whether having type 1 diabetes or type 2 diabetes at the time of diagnosis. The old paradigm that type 2 diabetes only occurs in adults and type 1 diabetes only occurs in children is no longer used because both types can occur at any age (24).

Diagnosis of DM

The diagnosis of DM is made on the basis of checking BG levels (20). In 2005, the WHO recommended that, as our guideline, the current WHO diagnostic criteria for diabetes should be maintained at fasting BG level of 7.0 mmol/l (126 mg/dl) or plasma glucose for 2 hours – 11.1 mmol/l (200 mg/dl) dl) (16,25,27,28). Despite the limitations of the data on which the diagnostic criteria for diabetes are based, the current criteria distinguish between groups with increased premature death and increased risk of microvascular and cardiovascular complications (1). On the other hand, the recommended BG test is an enzymatic glucose test using venous plasma blood (7,13,27).

The results of treatment can be monitored by using a BG meter to perform capillary BG checks (29). The diagnosis cannot be made based on the presence of diabetes. Various complaints can be found in DM patients. If presented with typical complaints, such as polyuria, polydipsia, polyphagia, and unexplained weight loss, the possibility of DM should be considered DM (4). Other accompanying complaints are weakness, tingling, itching, blurred eyes and erectile dysfunction in men, and genital itching in women (4,7,18).

The ADA states (30,31) that, when the BG level of symptomatic patients is more than 11.1 mmol/L, the diagnosis of DM must be established. Symptomatic patients with fasting BG> 7 mmol/L (6.1 mmol/L BG) will be reviewed at another day (25). If it is still higher than the limit, DM will be diagnosed (11,12,32). The ADA defines fasting BG between 6.1 and 7.0 (5.6-6.1 concentration BG) as impaired fasting BG (12).

The WHO (31,33,34) also recommends that the diagnosis of diabetes mellitus be made when the plasma glucose concentration is greater than 11.1 mmol/L (whole glucose concentration in venous blood is greater than 10 mmol/L) (34). Furthermore, a diagnosis of diabetes is made when the fasting plasma glucose concentration is greater than 7 mmol/L at two different periods or when an oral glucose tolerance test is performed. Aside from that, if the results of the oral glucose tolerance test are greater than 11.1 mmol/L, diagnosis of diabetes mellitus can be made (11,16,18,25).

The diagnosis of DM can be enforced in three ways: First, if a complaint is discovered, a BG check of 200 mg/dL is adequate to confirm the diagnosis of DM (13,15,35). For benchmark DM diagnosis, the second result of fasting BG levels of 126 mg/dL is also used. (34) The findings of the testing of glucose levels in new blood once are not normal for the group without symptoms indicative of DM, although they are strong enough to establish a clinical diagnosis of DM (36,37). Further validation is required in this scenario by obtaining the number no normal, a good fasting BG level of 126 mg/dL, or BG levels of 200 mg/dL on other days, or from aberrant oral glucose tolerance test results. The last one, determined by the Oral Glucose Tolerance Test (OGTT), has 2-hour plasma glucose levels of less than 200 mg/dL (11.1 mmol/L). The OGTT must be performed according to WHO guidelines, with a glucose load of 75 grams of glucose anhydrous dissolved in water (37–39).

Preoperative Management

The type of diabetes, glucose control, diagnostic time (a predictor of chronic problems), pharmacological therapy (oral, noninsulin, or insulin injectable antidiabetic medicines), dose and timing of drug administration should all be clarified during the initial examination of DM patients.(40) The disorder's dangerous risk factors for arterial blockages should be identified (sleep deprivation, poor lifestyle such as smoking, lack of exercise, hypertension, dyslipidemia, family history) (11,18). Communication with the patient and family prior to surgery is critical for confirming preoperative insulin and fasting instructions (1,28,41,42). For all non-emergency treatments, the patient should fast for up to two hours before the procedure, glucose-free clear fluids should be recommended to prevent hypovolemia, and sugar-containing clear fluids should be considered to treat hypoglycemia (38,43,44).

Acceptance of patients undergoing elective surgery should take place 1-2 days prior to surgery to ensure that the goal BG value is met (18). If the patient's BG value is in the 180 mg/dl range, surgery can be scheduled without further care, but if the number is between 181-300 mg/dl, an insulin pump may be considered before surgery (39,40,44,45).

In addition to the incidence of hyperglycemia, the

frequency of hypoglycemia must be assessed since it interferes with preoperative medication management, as well as the frequency of hospitalization for glycemic control (acute decompensation) (3,4,46). The patient's ability to measure his blood sugar and comprehend the concepts of diabetes medication should be assessed, as it has an impact on their perioperative management (2,24). The HbA1c test (hemoglobin A1c/glycohemoglobin) is highly recommended in pre-anesthesia preparation for DM patients because it is an examination that measures the average HbA1c or glycosylated hemoglobin level over three months, indicating how well BG has been controlled for the previous three months(40,47,48).

The following are the categories of HbA1c results, according to the American Diabetes Association: 6.0% for normal HbA1c, 6.0–6.4% for prediabetes, and 6.5% for diabetic HbA1c. As a result, for persons who have diabetes mellitus, in general, it is expected that good therapy would result in a positive outcome; HbA1c levels can fall to 6.5% (49–52).

If the HbA1c test result is over the usual range, it indicates the need to adopt diabetes-related lifestyle adjustments.(53) Meanwhile, the previous treatment for diabetes patients must be adjusted to the condition. Changes in treatment are most likely to include the type of medicine used and the dosage (23).

The diabetes state of the patient, as well as surgical risk factors, should be assessed. The anesthetic method to be utilized, the specifics of the surgery to be done, and laboratory values are all significant considerations.(54) Potential difficulties must be recognized, treated, and stabilized before surgery in the case of elective surgery. The major goal of preoperative evaluation is to assess metabolic control and diabetes-related comorbidities such as cardiovascular disease, autonomic illness, neuropathy, and nephropathy (52,55).

Furthermore, cardiovascular system abnormalities such as ischemic events must be considered; therefore, all DM patients should be tested at least with an ECG echocardiogram.(3) Patients with diabetic autonomic neuropathy are more likely to develop perioperative hypotension, thus there is a need to look for resting tachycardia, peripheral neuropathy, and orthostatic hypotension. To rule out the likelihood of diabetic nephropathy, serum urea and creatinine clearance level (CCR) should be assessed. Acute renal failure is more likely in diabetic people with inadequate creatinine clearance or proteinuria (49,56,57).

Intraoperative Management

Patients with diabetes should be treated with great care, with intraoperative considerations and the use of anesthetics and analgesics in the intraanesthetic induction phase used sparingly. Analgesia and anesthesia are used to assist prevent stress hyperglycemia (21,26). Major surgery lasts >2 hours and requires a long postoperative fasting time) so that a DM patient, should be listed first for surgery, shortening the preoperative fasting period and allowing food consumption. The fasting period for solid foods should last at least six hours, and the fasting period for clear fluids (no milk, no carbonated beverages) should last at least two hours (2,5,9).

Diabetes patients may have regional or general anesthesia, but any type of anesthetic helps reduce the stress reaction to surgery (5). For example, spinal or epidural anesthetic boosts catecholamine secretion, preventing hyperglycemia and ketoacidosis, and this effect might extend for several days after surgery, but it can also create difficulties (28). Because severe hypoglycemia impairs consciousness, recovery from general anesthesia may be delayed. Beta blockers raise blood sugar levels in those who don't have diabetes, but they also interfere with glucose homeostasis and hide hypoglycemia symptoms in diabetics (1).

To lessen the risk of stomach acid aspiration, patients with suspected gastroparesis should be given prokinetic medications before receiving general anesthesia. Furthermore, the optimum hemodynamic regimen should be applied on a continuous basis, with the understanding that hypotension can occur in diabetic autonomic neuropathy (1,2,23,29). During the intraoperative stage, hemodynamic monitoring, which includes blood pressure, pulse, body temperature, and respiratory blood pressure, is performed every five minutes to avoid unexpected spikes, which might further damage the ocular vessels and put the patient's overall condition in jeopardy. Regularly checking skin color and body temperature aids in the early detection of hypoglycemia (2,29). Precautions to take during surgery, both during anesthesia and surgery, include that aseptic and sterile technique must be strictly adhered to in order to avoid problems, infection risk, and neuropathy (2,5,7,9).

Other considerations need to identify the administration of general anesthesia and the type of anesthetic induction drug, such as propofol, that will be responsible for the decreased lipid metabolism ability in DM patients; therefore, the drug should be used with caution. A single dose of propofol is thought to be almost risk-free; however, prolonged intravenous/bolus/infusion for sedation in intensive care may raise the risk of hyperlipidemia (4,5,24,25).

Furthermore, because DM patients usually have difficulty with their airways (stiff joint syndrome), the intubation protocol needs professional talents and experience with these conditions, and the patient's quality of life will increase significantly (1,5).

a. Type 1 DM: If morning BG is at least 126 mg/dL, half of the whole morning insulin should be given

subcutaneously. Blood sugar levels should be tested one hour before surgery, at least once during operation, and every two hours afterward. When the patient begins to eat, routine insulin delivery begins(58).

b. Type 2 DM: Blood sugar should be monitored one hour before surgery and at least once throughout the procedure, and the oral hypoglycemic regimen stopped on the day of surgery. If the morning blood sugar level is at least 126 mg/dL, patients previously receiving therapy insulin should have subcutaneous insulin injection with a dose equal to half of the whole morning dose (55,59,60). Blood sugar levels need to be tested after surgery. If the patient's blood sugar level is at least 150 mg/dL in the morning (other sources 126 mg/dL), patient insulin is usually given at half dose SC morning administration, followed by infusion glucose 5% 1.5 cc/hour.

Next, in the operating room, isolate other IV access for a 5% dextrose infusion from other fluid administration channels. Check blood sugar every two hours commencing after insulin administration, every one hour intraoperatively, and 2-4 hours after surgery (10,14,21,32). When the patient's blood sugar falls below 100 mg/dL, dextrose supplements should be given (every ml of 50% glucose can boost BG by about 2 mg/day dL in adults weighing 70 kg). If intraoperative hyperglycemia (>150-180 mg/dL) arises, intravenous insulin can be given at a dose utilizing a sliding scale. One unit of insulin can reduce blood sugar levels by 20 to 30 milligrams per day (61–64).

Postoperative Management

Patients who require an IV insulin infusion may be changed to subcutaneous insulin if the infusion rate is constant and glucose control is achieved, especially if a diet has been started. Because the half-life of IV insulin is so short, subcutaneous insulin must be given before the IV insulin is stopped (45). Despite the fact that the rate of infusion during fasting is a good predictor of basal subcutaneous insulin demand, doctors often reduce the dose by 20% when converting (46).

If a patient needs 1.5 units of IV insulin per hour overnight, their basal insulin requirement is around 36 units per day. Lowering it by 20%, on the other hand, would result in a daily starting basal dose of 30 units of insulin (65). Dedicated pharmacists or diabetic specialists are available at some hospitals to assist with the transition from IV to subcutaneous insulin. It has been established that using a specialized team to manage diabetes in patients reduces readmission rates by 30 days, lowers diabetes inpatient costs, and improves follow-up and transition to care. Furthermore, if the diabetic team is consulted during the first 24 hours of admission, the length of stay is greatly reduced (28).

In hospitals, insulin therapy is still the standard of care. During the perioperative period, there will be two groups of diabetic patients: those who were previously on insulin and those who were not. Table I summarizes the various insulin kinds, as well as their onset and duration of action, and divides them into basal and bolus categories for use in the following lectures (40,41).

For glucose control, patients with diabetes who have been treated with subcutaneous insulin, oral medicines, or non-insulin injectable therapy but do not require IV insulin infusions, frequently require basal insulin therapy in the hospital (1,5,20). If basal insulin demands are unknown, 0.1 to 0.25 units/kg/day is a good place to start (66). Patients with insulin sensitivity (BMI type 1), the elderly, or having poor renal function should be started at the lower end of the range. Obese or insulin-resistant patients often require larger basal insulin doses. When the patient is eating well, pre-meal insulin (0.1 to 0.25 units/kg/day, or 0.03 to 0.08 units/kg/meal) is frequently required (67).

DISCUSSION

The perioperative care of diabetes is a difficult process that is best conducted by a multidisciplinary team because it is dependent on numerous factors. When it comes to the impact on morbidity and mortality, avoiding swings in BG levels perioperatively is just as critical as maintaining low BG levels. The American Diabetes Association (2015) recommends that blood glucose levels in hospitalized patients be kept below >180 mg/dl at all times. Many treatment techniques are currently established on each hospital's protocol; for example, patients who get subcutaneous insulin have their schema maintained during their hospital stay.

Table I: Recommendation for insulin control preoperatively and postoperatively for individuals who are already on insulin.

Medication	Preoperative	Postoperative
Basal Insulin	Long-Acting: Reduce the dose by 20–25 percent the night before or the day of operation. Half-dose NPH (intermediate-acting) All daily dosages are premixed, and the basal insulin is half as long-acting. All of your insulin should be pre-mixed.	Continue reduced dose while NPO
Prandial Insulin	If there is indications of over-covering on the day before surgery, reduce coverage for the last meal. The day of operation will be postponed.	Hold until there is reliable prandial intake

NPO, nothing per Oral.
NPH, Neutral Protamine Hagedorn

However, there is consensus on matters such as placing diabetic patients first on the operating list, perioperative blood glucose monitoring, the efficacy of intravenous insulin and/or glucose solutions, and resuming food intake as soon as feasible postoperatively. The practices discussed in this review are neither comprehensive nor detailed; for example, we have not addressed the broad principles of perioperative care, or patients who are given corticosteroids, receive parenteral nutrition, or have renal impairment. Because most studies have looked at perioperative diabetes care in patients undergoing cardiac surgery or in critically sick patients, further study is needed to determine which therapies are best for patients with diabetes who are undergoing other operations, such as general surgery. In any case, each treatment plan, both surgical and non-surgical, must be tailored to the specific needs of each patient.

The objectives of diabetes perioperative care are to reduce morbidity and mortality. In order to obtain such, in this scenario, the focus is on using various pharmaceutical therapy to reduce hyperglycemia and hypoglycemia. Despite the lack of consensus and strong studies, a number of perioperative diabetes treatment suggestions can be made, and these have been covered. More study is needed to back up a number of our empirical findings.

CONCLUSION

DM is a metabolic illness that frequently affects surgical patients and requires a specific treatment plan. Patients with diabetes who are going to have surgery need perioperative treatment that focuses on improving BG control and paying attention to any existing comorbidities so that complications during or after surgery can be avoided. Hyperglycemia can be avoided, which reduces postoperative morbidity, mortality, and infection. Insulin therapy, insulin sliding scales, and insulin infusion are all options for preventing hyperglycemia. Increased blood sugar levels in diabetic and nondiabetic patients are now associated to an increased risk of perioperative complications. Treatment with insulin before and after surgery has been shown to improve clinical results. Patient features and surgical case concerns are taken into account when determining whether to use subcutaneous insulin or insulin infusion.

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