Review paper

Perioperative management of patients with diabetes

Postępowanie okołooperacyjne u pacjentów z cukrzycą

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Abstract

The prevalence of diabetes mellitus has been steadily increasing rapidly in recent years. Risk factors include obesity and lack of physical activity. Not only is it the most common endocrine disease in Europe, but also it is widely prevalent worldwide. Hyperglycaemia and diabetes were responsible for about 6.7 million deaths worldwide and 1.1 million deaths in Europe in 2021. Diabetes has a significant impact on the economy as well. This is a common disorder in surgical patients and proper anaesthesiology management of this disease is the single most important issue, though still poorly understood. Patients with diabetes mellitus have a higher risk of difficult intubation and aspiration. Diabetics undergoing surgery are particularly at risk of postoperative complications and increased mortality. In this review, the authors discuss the perioperative considerations in managing patients with diabetes as well as those without diabetes, albeit hyperglycaemic.

Streszczenie

Częstość występowania cukrzycy i jej czynników ryzyka, w tym otyłości i braku aktywności fizycznej, w ostatnich latach gwałtownie wzrasta. Jest to nie tylko najczęstsza choroba endokrynologiczna w Europie, lecz także szeroko rozpowszechniona na świecie. Hiperglikemia i cukrzyca odpowiadają za około 6,7 mln zgonów na świecie i 1,1 mln zgonów w Europie w 2021 roku. Cukrzyca ma również znaczący wpływ na gospodarkę. Stanowi częste zaburzenie u pacjentów chirurgicznych i właściwe postępowanie anestezjologiczne w tej chorobie jest najważniejszym zagadnieniem, choć wciąż słabo poznanym. U pacjentów z cukrzycą występuje większe ryzyko trudnej intubacji i aspiracji. Chorzy na cukrzycę poddawani zabiegom chirurgicznym są szczególnie narażeni na powikłania pooperacyjne i zwiększoną śmiertelność. W niniejszym przeglądzie autorzy omawiają rozważania okołooperacyjne dotyczące postępowania u chorych z cukrzycą, jak również u chorych bez cukrzycy, jednak z hiperglikemią.

Introduction

Diabetes mellitus (DM) is a metabolic disease characterized by abnormally elevated blood glucose levels. This abnormal elevated glucose level is caused by insulin resistance or is insulin-dependent and is a chronic condition in which the pancreas produces little or no insulin. Several types of diabetes mellitus are known, including type 1 and type 2 diabetes, which are the most common and well-described subtypes, but also maturity-onset diabetes of the young (MODY), gestational diabetes, neonatal diabetes, and secondary diabetes caused by, for example, iatrogenic treatment, such as corticosteroid therapy [1, 2]. Normal blood sugar levels are from 4.0 to 5.4 mmol/l (72 to 99 mg/dl) when fasting and up to 7.8 mmol/l (140 mg/dl) 2 h after eating [3]. A finding of more than 140 mg/dl 7.8 mmol/l but not more than 199/dl 11.0 mmol/l indicates postprandial hyperglycaemia and prediabetes. However, a value above 200 mg/dl 11.1 mmol/l indicates diabetes. Insulin supplementation is the treatment of choice in 31% of diabetic patients, with approximately 15% using insulin only and 13.6 ±11.1% as an accessory treatment to-

gether with antidiabetic oral medications [4]. DM is described in many studies as a non-infectious epidemic of the 21st century. The incidence has a continuous increasing trend, and it is estimated that over 135 million people suffer from this disease worldwide. The prediction is that this number can increase to more than 300 million individuals developing diabetes by the end of 2025 [1, 5]. Patients diagnosed with diabetes mellitus are, due to their frequent cardiovascular comorbidities, more likely to require hospitalizations and surgical interventions, and even display higher mortality rates compared to healthy patients [6, 7]. Chronic hyperglycaemia, which occurs in diabetes mellitus, is also associated with long-term damage, dysfunction, and organ failure, not just the cardiovascular system; thus, proper management of diabetes mellitus is the single most important issue, though still poorly understood [8]. In order to avoid complications attributed to surgery for diabetic patients, such as urinary tract infections, sepsis, acute renal failure, or other reasons for an intensive care unit admission, good perioperative blood glucose control and adequate patient care during anaesthesia are essential [9]. The authors intentionally omitted the topic of perioperative management in children and adolescents with diabetes due to the vastness of the topic.

Diabetes therapy

HbA_{1c} value

According to the latest recommendations, glycated hemoglobin (HbA_{1c}) should be determined for each diabetic patient. This also applies to patients with a diabetes risk factor or preoperative blood glucose levels > 140 mg/ml. The HbA_{1c} value serves as a measure of blood glucose control in the preoperative state. Elective surgery should not be performed with HbA_{1c} > 8.5 to 9.0% or with blood glucose > 250 mg/dl. First, the patient's glucose balance must be optimized. High levels of HbA_{1c} lead to a situation in which immunocompetent cells are glycosylated and the patient is in an immunosuppressive state. In addition, high blood glucose levels can affect the function of neutrophils (neutrophil granulocytes), which produce substances that trigger pro-coagulation in the body [9].

Monitoring the effectiveness of treatment of diabetes mellitus

The most important is the determination of the HbA_{1c} value, which represents the average glucose values of the last 6 weeks. It is also possible to arrange three daily blood glucose profiles. In diabetic patients, urine should also be tested for glycosuria, acetonuria and/or microalbuminuria. It can be assessed whether the treatment is going to be effective by checking C-peptide values, which will indicate secretory function of β cells. Remember that the endogenous daily insulin production is about 40–50 IU. A well-managed type I diabetes patient is characterized by normoglycaemia and lacking glycosuria and ketonuria [9].

Anaesthetic management

Significant comorbidities of diabetic patients and anaesthesia

To provide the patient with the best possible care and safety during and after surgery, it is necessary to take a thorough medical history with the patient and to know the comorbidities that are significant for the choice of anaesthesia for each patient and perioperative care. Comorbidities with the most significant medical consequences for diabetic patients are micro- and microangiopathies, which may lead to development of coagulopathies, peripheral artery disease, coronary heart disease and increased risk of infections (antibiotics therapy after the procedure is needed); autonomic neuropathy, which includes gastroparesis, diminished heart rate increase during exercise, painless angina pectoris and risk of silent myocardial infarction; peripheral polyneuropathy (loss of vibratory sensation and the Achilles tendon reflex), nephropathy and diabetic retinopathy [10].

Preoperative assessment

Preoperative assessment of patients with diabetes mellitus is highly required before any surgical intervention, to avoid severe complications and minimize the risk of perioperative death. It includes evaluation of onset time of the disease, type of diabetes, medication regimen, as well as metabolic compensation and any diabetes-related complications, including autonomic neuropathy, cardiovascular disease, and nephropathy, that may further influence the surgical outcome of a patient. During the presurgical visit, chronic micro- and macrovascular sequelae of diabetes should be objectified, e.g., by assessing laboratory blood and urine values, vascular status, ECG: in particular, fasting glucose, HbA_{1c}, urea, creatinine clearance, electrolytes, and triglycerides [11]. Another potential effective tool for the determination of severity of the patient's condition with serious diseases associated with glycaemic disorders is serum procalcitonin level, mainly in patients with acute necrotic pancreatitis [12].

The preoperative target for HbA_{1c} is agreed at < 8.5% (69 mmol/mol). Elevated preoperative HbA_{1c} levels are associated with worse surgical outcomes, while the upper limit of HbA_{1c} values for planned surgery should not be > 8–9% (64–75 mmol/mol) [11]. In the preoperative period, the target for fasting blood glucose value should be 80–180 mg/dl (4.4–10.0 mmol/l) [13]. In the case of severe hyperglycaemia (> 250 mg/dl) or metabolic decompensation (diabetic ketoacidosis or

hyperosmolar syndrome with hyperglycaemia), it is recommended to postpone surgery until the patient achieves better glycaemic control [14]. It is also critical to take a thorough patient history and focus attention on aspects that may alert about upcoming anaesthesia challenges, for example gastroparesis (increased risk of aspiration with HbA_{1c} > 9%) or possible intubation problems that may occur because of the effects of diabetes on the musculoskeletal system. The most important and challenging cases are those of patients with stiff joint syndrome, which is characterized by early onset diabetes, joint contractures, and low stature; it is more common in patients with type 1 diabetes but may also occur in people with type 2 diabetes. The exact pathogenesis of stiff joint syndrome is not yet well understood, but it is thought that it may arise because of non-enzymatic glycosylation of collagen and its deposition in joints, resulting in reduced joint mobility. A huge challenge for anaesthesiologists is when this syndrome affects the atlanto-occipital joint, which makes extension of the head and tracheal intubation impossible. The cause of difficulty in intubation in diabetic patients is not only the stiff joint syndrome, but also the short thyromental distance, short sternoclavicular distance, and limited mobility of the head, neck, and mandible [11].

Perioperative management

Perioperative management can be divided into three phases: preoperative, intraoperative, and postoperative. In the preoperative phase we should assess the patient carefully, as described in detail in the previous part; at the same time, we must consider that certain diabetic medications that the patient could be taking will need to be discontinued for the duration of the surgery or taken with extreme caution (Table 1) [15–18]. Perioperative management is somewhat complicated when so many complications are at hand. The main concern of intraoperative management is to keep capillary blood glucose (CBG) and electrolytes at a proper level, as well as having good renal perfusion with optimal cardiovascular parameters [7]. An intraoperative CBG of 6–10 mmol/l is recommended, with an upper limit of 12 mmol/l. These values are acceptable in patients with diabetes difficult to control or patients with modification of their medications (without usage of variable rate intravenous insulin infusion (VRIII)). What is of particular importance is the treatment of intraoperative hypo- and hyperglycaemia. Hyperglycaemia with 12 mmol/l with omitted insulin, blood, and urine ketones should be measured to investigate for ketoacidosis. Diabetic ketoacidosis can be diagnosed based on the following criteria: blood glucose greater than 250 mg/dl, arterial pH less than 7.3, serum bicarbonate less than 15 mEq/l, and the presence of ketonemia or ketonuria. If no ketoacidosis is discovered, subcutaneous insulin can be administered or VRIII can be adjusted. In patients with type 1 diabetes mellitus, subcutaneous short-acting insulin would be the insulin of choice, with a maximum of 6 IU. Type 2 diabetes would be a different matter, while also short-acting insulin would be used, with 0.1 IU/kg. In both cases, CBG should be checked hourly and be falling by 3 mmol/l per 1 IU administered. The not too severe hypoglycaemia of 4–6 mmol/l 50 ml of 20% glucose *i.v.* could be administered and in a more severe state 100 ml of the same fluid. It is important to note that there are no benefits of keeping the CBG under 6 mmol/l [7].

Contraindications for anaesthesia and diabetes

Both anaesthesia and surgery can aggravate the patient's condition as well as induce complications. Poorly controlled glucose increases the risk of ketoacidosis, postoperative infectious complications and even mortality in this group of diabetic patients [19]. In theory, diabetic patients with a compromised metabolic state (ketoacidosis or hyperosmolar hyperglycaemic state (HHS)) should not undergo elective surgery. There is no established routine to disqualify diabetic patients from surgery; however, it is recommended that patients undergoing surgery with glucose greater than 400 mg/dl should be postponed [20]. For proper intubating conditions, an empty stomach is imperative; thus patients with gastroparesis as a complication of diabetes should be diagnosed before surgery, if not earlier, with the symptoms of abdominal pain, anorexia and bloating as possible warning signs [21]. In regional anaesthesia, there are practically no contraindications, even in peripheral neuropathy; even though local anaesthesia is found to be more toxic in diabetic neuropathy, patients should still not be disqualified from the procedure. Infection with diabetes is a risk, which should be taken into consideration when peripheral nerve catheters are used [22]. Diabetic nephropathy is one of the more serious concerns during anaesthesia, as diabetes itself comes with a risk of developing acute kidney injury in the perioperative period, even if no dysfunction was noted before. Assessment of preoperative GFR is essential, as unstable and poorly controlled glycaemia can worsen the condition further and lead to further morbidity. It is imperative to avoid nephrotoxic agents but overall haemodynamic control is also crucial [23]. Risk of cardiovascular disease (CVD) disease is commonly noted in diabetic patients, with around 75% mortality from complications of atherosclerosis. At the same time, silent myocardial infarction is found more often in diabetic patients. Thus, the preoperative assessment of the cardiovascular system, with ECG, exercise tolerance tests, stress echography and troponin, is crucial. Patients with newfound CVD should be referred to the cardiologist for further investigations before any anaesthesia can be considered [23].

Table 1. Treatment of diabetes mellitus [9, 15–18]

Group	Example	Characteristics			Preoperative dosage
		Oral hypoglycaemic medications			
Biguanides (p.o.)	Metformin	↓ Hepatic gluconeogenesis and lipogenesis ↑ Insulin-mediated uptake of glucose in muscles			Skip the dose
α-glucosidase inhibitors (p.o.)	Acarbose	↓ Polysaccharide reabsorption			Skip the dose
Dipeptidyl peptidase IV inhibitors (DPP-4); "gliptins" (p.o.)	Sitagliptin, vildagliptin	↓ Glucagon release ↑ Glucose-dependent insulin release ↓ Gastric emptying ↑ Satiety			Continue regular doses
Thiazolidinediones, Glitazone (p.o.)	Pioglitazone	↑ Insulin sensitivity			Skip the dose
Glucagonlike-peptide-1 (GLP-1) agonist (s.c.)	Liraglutide	↑ Glucose-dependent insulin release			Skip the dose
Sodium-glucose transporter-2 (SGLT-2) inhibitors; "flozins" (p.o.)	Empagliflozin, dapagliflozin	↓ Glucose reabsorption and resulting in glycosuria			Skip the dose
Sulfonylureas (p.o.)	Gliclazide, glimepiride	↑ Insulin secretion Risk of hypoglycaemia			Skip the dose
Human amylin analogue (s.c.)	Pramlintide	↓ Glucagon release			Skip the dose
Non-sulfonylurea insulin secretagogues; "glinides" (p.o.)	Repaglinide, meglitinide	↑ Insulin secretion Risk of hypoglycaemia			Skip the dose
		Insulins			
Variable		**Onset**	**Peak effect [h]**	**Duration [h]**	**Preoperative dosage**
Rapid-acting analogue of human insulin	Insulin aspart Insulin glulisine Insulin Lispro	10–20 min	1–3	3–5	–
Short-acting insulin	Regular (R)	30–60 min	1–3	6–8	–
Intermediate-acting	Neutral protamine Hagedorn (NPH) – isophane human insulin suspension	1–2 h	4–12	18–20	Take regular doses the day before surgery and 50% on the day of surgery
Pre-mixed	Humulin M3 (30/70) 30 (30% regular insulin/70% NPH insulin)	30 min	2–8	> 14	Take 75–100% of dose the day before surgery and if morning BG is > 200 mg/dl take 50% of dose, if £ 200 mg/dl skip dose
Long-acting analogue of human insulin	Insulin degludec Insulin detemir Insulin glargine	1–3 h	Peakless	42 20–24 24	Take 75% of dose the day before surgery and 50% on the day of surgery

Insulin resistance during surgery

It is a normal response of the body to react in a neuroendocrine way to injury; however, in a surgical setting, this response is proportionally bigger than the perceived injury [9]. As a physiological response of the human body to injury, within minutes, there is an immediate, rapid release of glucagon, cortisol, and growth hormone, as well as an inflammatory response in the form of catecholamines. All anabolic processes come to a halt and the release of all possible fluids is necessary for the human body to rebuild the tissues after perceived stress [14]. The main concern for the diabetic patient is the inactivation of insulin during these responses. It has been thought that this response is beneficial for the post-surgery outcome, and arguably, it has been proven that during acute haemorrhage it may be beneficial for mobilizing glucose. But in other cases it has shown longer and more complicated postoperative recovery [14]. In short, the catabolic processes that favour gluconeogenesis, ketogenesis and proteolysis and lipolysis, and thus the anabolic function of insulin, are much disfavoured in intraoperative conditions due to stress. Longer fasting periods before the surgery (> 12 h) have also shown peripheral insulin activity [9]. The best chance to limit the effects of insulin resistance in intraoperative conditions is to stop or limit the said neuroendocrine and inflammatory response overall before the resistance can reoccur. Local anaesthesia in the form of neuraxial block, especially, can block the effects of stress caused by surgical stimuli and, in consequence, block the sympathetic and adrenergic response [9]. Regional anaesthesia is preferred for DM patients, with a faster recovery to normal fluid and food intake and quicker return to the normal antidiabetic medications [11].

Intraoperative insulin therapy

According to data presented by the Endocrine Society, it is recommended to maintain intraoperative blood glucose levels < 180 mg/dl [3]. If a patient's blood glucose level exceeds 180 mg/dl subcutaneous (SC) rapid-acting insulin analogues or an intravenous infusion of regular insulin should be used to lower it. In patients undergoing procedures of short duration (< 4 h) with expected haemodynamic stability and minimal fluid shift, it is recommended and safe to use SC insulin treatment [24]. It is very important to remember that rapid-acting insulin should not be given more frequently than every 2 h and patient's blood glucose should be controlled every 2 h during the procedure. However, in cases of expected haemodynamic changes, significant fluid shifts or more extensive procedures (> 4 h) it is recommended to use an intravenous infusion of insulin. In this case, blood glucose should be monitored every 1–2 h. If the patient's blood glucose level during the procedure falls below 70, we must stop insulin therapy and administer a bolus of 50% dextrose (25 ml) or 10% dextrose infusion; when glucose levels are ≤ 50, 50% dextrose (50 ml) should be administered [25] (Table 2).

Table 2. Adjustment scheme of the insulin infusion protocol [9]

Actual blood glucose [mg/dl]	Blood glucose level increased compared to the previous blood glucose level	Blood glucose decreased by < 30 mg/dl compared to the previous blood glucose	Blood glucose level decreased by > 30 mg/dl compared to the previous blood glucose level
> 210	↑ by 2 IU/h	↑ by 2 IU/h	No modification
181–210	↑ by 1 IU/h	↑ by 1 IU/h	No modification
141–180	No modification	No modification	↓ by 0.5 IU/h
125–140	No modification	↓ by 0.5 IU/h	↓ by 1 IU/h
100–124	No modification	↓ by 1 IU/h	Stop insulin supply

Actual blood glucose [mg/dl]		
75–99		• Blood glucose controls every 30 min until blood glucose > 90 mg/dl • Continue therapy after 30 min at 75% of previous walk rate at: – BG > 100 mg/dl for patients with type 1 diabetes – BG > 140 mg/dl for patients with type 2 diabetes
50–74	Stop insulin supply	• **30 ml 40% glucose (12 g) i.v.** • Blood glucose controls every 15 min until blood glucose > 90 mg/dl • Continue therapy after 30 min at 50% of previous walk rate at: – BG > 100 mg/dl for patients with type 1 diabetes – BG > 180 mg/dl for patients with type 2 diabetes
< 50		• **60 ml 40% glucose (24 g) i.v.** • Blood glucose controls as above • Continue therapy as above

Choice of anaesthetic technique

The administration of local anaesthesia as a sole anaesthesia is preferred overall due to its limited side effects, especially of nausea and vomiting. Combined local and general anaesthesia is shown to significantly decrease the need for opioids, thus reducing the negative side effects of opioids, especially for diabetic patients. On the downside, studies have shown that diabetic surgical patients are more prone to complications of regional anaesthesia such as epidural abscesses or haemodynamic instability after neuraxial blockade, although the latter is mostly due to already existing autonomic neuropathy. The other concerns that are of less certain are the risks of neuropathy after peripheral nerve block [7]. Opioids are not readily recommended in higher doses than can be spared, since they raise blood glucose levels, and longer duration of use is associated with slightly worse diabetic performance [26, 27]. This is not to say that opioids have only negative effects; there are many reports of the benefits of inhibiting catabolic processes which can help achieve a more stable metabolic and hormonal state [28]. Benzodiazepines have been shown to alter insulin sensitivity and secretion, especially clonazepam [29]. Benzodiazepines depress the sympathetic nervous system and may increase the release of growth hormone and may alter the glycaemic response. These effects are not as significant in midazolam in sedation doses, but are more so for longer duration infusions [28].

The most common volatile anaesthetics (desflurane and sevoflurane) appear to be safe drugs that can be used in diabetic patients, but there are few data in the literature to support this. A randomised trial on normoglycaemic patients confirmed that anaesthesia with desflurane, sevoflurane and propofol resulted in an increase in plasma glucose levels, but within normal limits [30]. In contrast, in an animal model, it was found that neither desflurane nor sevoflurane increased the blood glucose levels in patients with induced hyperglycaemia [31].

When using barbiturates, mainly thiopental, special care must be taken in patients with metabolic diseases including diabetes, as it reduces the body's glucose consumption, which has been proven in animal models [32, 33]. Barbiturates interact with sulfonylureas, prolonging their action, which may cause hypoglycaemia [34]. Recently synthesised barbiturate derivatives have been shown to be potent inhibitors of α-glucosidase, raising hopes for their future replacement by acarbose [35].

Etomidate, a potent inhibitor of cortisol and aldosterone synthesis, has been found to decrease the glycaemic response to surgery by approximately 1 mmol per litre in non-diabetic patients [36, 37]. One study in rats showed that etomidate has neuroprotective effects on neuronal tissue, protecting it from diabetes-induced oxidative damage [38].

In the case of ketamine, the literature does not describe significant complications after its use in groups of patients with diabetes. Only slight and harmless, rapidly resolving increases in blood pressure and heart rate have been rarely reported [8]. Studies in rats have shown that diabetic patients may be at risk of hyperglycaemia when treated with ketamine [39].

Halothane, enflurane and isoflurane may reversibly interfere with the insulin response in a diabetic patient, but are not commonly used volatile agents [28].

Diabetes and C-section

Pre-existing diabetes in pregnancy comes with a high risk of emergency caesarean section (CS). Nulliparity, previous CS and hypertensive conditions increase the risk further [40]. The overall risk for non-elective CS can also increase in gestational diabetes mellitus (GDM), with 19.5% of GDM women ending up with a non-elective CS [41].

The perioperative stress does bring about a response in the form of hyperglycaemia, which is why blood sugar level should be controlled as much as possible during anaesthesia, especially in the case of diabetic mothers. It is well known that the type of anaesthesia is significant in the level of perioperative hyperglycaemia, with general anaesthesia producing the biggest increase, spinal anaesthesia being overall more beneficial. In fact, the type of anaesthesia was found to be the biggest independent factor affecting postoperative sugar levels [42].

The practical approach to such patients should consist of several approaches. A diabetic mother is always a high-risk case, independent of type of delivery; therefore this group of patients should be under a well-controlled medical environment with specialist-led medical care. Another option is the continuous blood glucose control, which also reduces the risk of neonatal hypoglycaemia [43].

CS in diabetic women should include conditions in which these patients are at greater risk (such as renal dysfunction, hypertension) but also indirect consequences of autonomic neuropathy (e.g. silent MI, decreased response to medications (atropine, β-blockers), gastroparesis and resting tachycardia) [43].

During surgery, it is essential to strive towards optimal glycaemic control. This can be achieved by infusion of short-acting insulin and hourly glucose plasma measurements [43]. If the blood glucose does rise above 120 mg/dl, *i.v.* infusion of insulin may be used to decrease the glycaemia to target levels. It is discouraged that any glucose containing solution goes into the same i.v. line. 5% glucose solution can be given in an infusion pump in another line, as needed [43].

Even if general anaesthesia (GA) is not the preferred method, it is sometimes necessary in DM women at risk of non-elective CS. Metoclopramide (10 mg) can be used to quicken the gastric emptying.

All instruments that may be applied in case of difficult airway intubation, as well as medication, should be readily available. The cardiovascular response to hypoglycaemia may be blunted during GA; thus half-hourly blood glucose control is recommended [43].

DM women during CS may indeed benefit from epidural anaesthesia, especially in severe DM, as the sympathetic blockade may be slower to work [44].

In conclusion, as DM women have higher risk of non-elective CS, and as both the type of anaesthesia and glycaemic control are critical to the outcome of the CS, these deliveries must be closely monitored and all the complications of DM should be taken into consideration.

Diabetes complications

Diabetes mellitus is one of the major causes of morbidity and mortality, due to the common consequences of the disease. The chronic complications of diabetes can be divided into two main groups, microvascular (involving small vessels as capillaries) and macrovascular (involving veins and arteries). Microvascular complications include diabetic retinopathy, diabetic neuropathy, and diabetic nephropathy. Diabetic retinopathy is one of the major neurovascular complications of diabetes and is a leading cause of blindness in adults of working age. It may affect the peripheral retina, macula, or both retinas and is the leading cause of impaired vision and blindness in people with diabetes. The degree of severity of diabetic retinopathy ranges from nonproliferative and preproliferative to more severe proliferative diabetic retinopathy in which there is abnormal new vessel growth [45]. According to the Rochester Diabetic Neuropathy Study from 1993 approximately one half of patients with diabetes have some form of peripheral neuropathy. Diabetic neuropathy is defined as the presence of subjective or clinical features of peripheral nervous system damage during diabetes, after excluding other possible causes of symptoms. Symptoms and complaints reported by patients with diabetic neuropathy are the consequence of disease involvement of sensory, motor and autonomic parts of the nervous system [46]. Diabetic nephropathy is one of the most serious diabetic complications, and it is currently the main cause of end-stage renal disease and the need for renal replacement therapy. The progressive loss of kidney function is accompanied by long-term damage to many organs and systems and an increase in morbidity and mortality. The early diagnosis of diabetic nephropathy allows for the implementation of management leading to the reversal or slowing of changes in the kidneys [44]. The macrovascular complications of diabetes mellitus include coronary artery disease, cardiac arrhythmias, cardiomyopathy, cerebrovascular disease, and peripheral artery disease. Many clinical studies have shown an association between diabetes mellitus and vascular disease, because diabetic patients very often have other risk factors such as hypertension, obesity, and dyslipidaemia. Cardiovascular diseases are the leading cause of death in diabetic patients [47].

Conclusions

There are no specific techniques or agents in anaesthesiology that are indicated in the management of patient with diabetes. Patients with diabetes have an increased risk of aspiration of gastrointestinal contents into the airways because of symptomatic gastroparesis. For this reason, in these patients undergoing general anaesthesia, rapid sequence induction and intubation should be kept in mind. Therefore, regional anaesthesia may be a beneficial option, but a detailed neurological examination of the patient, particularly of the areas supplied by the peripheral nerves, is important. It is extremely important to position the patient's lower limbs correctly, as they easily become ischaemic, exacerbating neurovascular complications. Patients with advanced diabetes may require urinary glucose monitoring and osmotic diuresis. Bladder catheterisation may be necessary for this purpose. Given the facts and knowing the risks of complications, patients with extremely unstable diabetes may require post-operative care in the intensive care unit.

Conflict of interest

The authors declare no conflict of interest.

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