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Q1 Position Statement/Recommendations

Practical management of diabetes patients before, during and after surgery: A joint French diabetology and anaesthesiology position statement

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Abbreviations

ACR	albumin-to-creatinine ratio
CAN	cardiac autonomic neuropathy
BNP	brain natriuretic peptide
CSII	continuous subcutaneous insulin infusion
GDM	gestational diabetes mellitus
GLP-1	glucagon-like peptide 1
GP	general practitioner
HF	heart failure
ICU	intensive care unit
ISPAD	International Society for Pediatric and Adolescent Diabetes
IU	international unit(s)
IV	intravenous
IVII	intravenous insulin infusion
SFAR	French Society of Anaesthesia and Resuscitation
OAD	oral antidiabetic drug
PACU	post-anaesthesia care unit
SC	subcutaneous
SFAR	French Society of Anaesthesia and Intensive Care
SFD	French-Speaking Society of Diabetes
SMI	silent myocardial ischaemia
T1D	type 1 diabetes
T2D	type 2 diabetes

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Introduction

Diabetes is a worldwide disorder. Despite huge advances in care management, diabetes patients may nevertheless suffer from cardiovascular and microvascular complications, which may explain their need for surgery more often than non-diabetes patients. Likewise, known or unknown diabetes increases perioperative risks from, for example, the surgical procedures themselves, anaesthetic drugs, fasting, infusions, associated treatment and stress.

Therefore, diabetes patients should be given special attention before, during and after surgery. In this context, experts from both the French-Speaking Society of Diabetes (SFD; Société francophone du diabète) and French Society of Anaesthesia and Resuscitation (SFAR; Société française d'anesthésie et de réanimation) met to devise the following guidelines. The full text is published in French and English, with 20 pages created by the Working Group to illustrate how the guidelines apply in daily practice (http://sfar.org/gestion-du-patient-diabetique/). The present report is a comprehensive support text particularly dedicated to diabetologists not only for their own uses, but also as an educational tool to communicate with anaesthesiologists.

Materials and methods

A group of experts (six diabetologists: E.C., B.C., S.J., A.M.L., I.T., P.V.; and four anaesthesiologists: D.B., C.G., C.I., A.O.) met twice a year between November 2014 and April 2017 in Paris, France, to review the literature, and discuss and write the text of the following expert opinion. Due to the limited number of validated studies, recommendations were not graded and the text should be considered expert advice.

Results

Preoperative management of adult patients with diabetes

Identification of patients with diabetes and at risk for stress hyperglycaemia

Known diabetes: different types, main acute complications and treatment (what should anaesthesiologists know?) (Appendix A). Type 2 diabetes (T2D), the most common form of diabetes, is often discovered as an insidious disease because it is asymptomatic at the time of screening high-risk patients [1]. Thus, T2D may be detected when a patient attends hospital for surgery, when chronic complications are already present. The main risk is a hyperosmolar hyperglycaemic state when polyuria/glycosuria and hyperglycaemia (> 1.8 g/L or 10 mmol/L) are not compensated for by polydipsia, or parenteral hydration in an unconscious patient. Patients with T2D may require oral antidiabetic drugs (OADs) such as sulphonylureas, which enhance endogenous insulin secretion and may be responsible for hypoglycaemias. Injectable glucagon-like peptide (GLP)-1 receptor agonists, including those that can be injected weekly, reduce the speed at which the stomach empties after a meal, thereby leading to gastroparesis (Appendix B). Insulin may be combined with these drugs.

Type 1 diabetes (T1D) is linked to the autoimmune destruction of pancreatic β cells, which synthesize insulin. The two components for physiological secretion of insulin are then no longer active, namely:

- 'basal' secretion or 'insulin for daily living', which is continuous over the nycthemeral period and represents approximately 50% of daily requirements;
- prandial secretion or 'mealtime insulin'.

Substitution of basal insulin should never be stopped, not even in subjects with euglycaemia, due to the major risk of hyperglycaemia followed by ketosis and diabetic ketoacidosis. In general, patients with T1D are familiar with this rule of survival. Continuous subcutaneous (SC) insulin infusion (CSII) is often used in T1D, as it reproduces basal–bolus delivery through discontinuous SC injections of slow-acting and ultrarapid insulin analogues (Appendix C). Thus, continuous infusion of a small amount of ultrarapid insulin reproduces basal insulin and is the basal output.

'Pancreatic' diabetes secondary to pancreatic disorders is less common, but also presents with severe insulinopenia, with an increased risk of hypoglycaemia because of a simultaneous decrease in glucagon secretion. Other types of diabetes are extremely rare.

Stress hyperglycaemia and undiagnosed preexisting dysglycaemia.

Stress hyperglycaemia. Surgical procedures and their inherent metabolic effects can induce a stressed state causing perioperative hyperglycaemia, known as 'stress hyperglycaemia'. According to the American Diabetes Association (ADA), this is defined as transient hyperglycaemia in a previously non-diabetic patient during an acute illness or an invasive procedure [1]. It is characterized by plasma glucose levels ≥ 1.8 g/L (10 mmol/L), with levels returning to normal (< 1.26 g/L or 7.0 mmol/L) after removal of the stressor and withdrawal of glucose-lowering treatment in patients previously with an HbA1c < 6.5%. The severity of stress hyperglycaemia depends on the type of surgery, invasiveness of the procedure and its duration [2], with the highest prevalence noted during cardiac surgery. Other risk factors include catecholamine infusion, corticosteroid use, obesity, age, hypothermia, hypoxia, cirrhosis, trauma, extensive burns and sepsis [2].

The main mechanism responsible for perioperative stress hyperglycaemia is peripheral insulin resistance with an increase in endogenous glucose production [3]. In addition, renal reabsorption of glucose is increased and/or glucose clearance decreased. Stress hormones (glucagon, cortisol, catecholamines) and mediators of inflammation [interleukin (IL)-1, IL-6] released during surgical stress can lead to perioperative insulin resistance. This affects lipid metabolism with increased release of free fatty acids (FFAs), thus further aggravating insulin resistance [3]. Perioperative insulin resistance may last for several days after an invasive procedure and initially involves insulin-dependent peripheral tissues [3]. Perioperative blood loss as well as prolonged immobilization both affect glucose metabolism in skeletal muscles and accentuate perioperative insulin resistance. In addition, prolonged perioperative fasting induces a decrease in hepatic glycogen supply, and an increase in neoglucogenesis, and lipid and protein metabolism [2].

Hyperglycaemia abolishes ischaemic preconditioning and results in endothelial dysfunction and decreased phagocytic activity of polymorphonuclear neutrophils, while increasing the formation of lesions in a murine blood–brain barrier model of cerebral ischaemia. These deleterious effects of hyperglycaemia are caused by mitochondrial abnormalities in non-insulin-dependent cells, where glucose transporters are overexpressed during stress [2]. The increased release of FFAs is potentially harmful to myocardium as they modify protein metabolism, leading to increased protein catabolism and delayed healing. Insulin therapy mitigates the consequences of insulin resistance, such as the postoperative neurohormonal response to stress and perioperative release of FFAs from peripheral tissues during surgery [2].

Undiagnosed preexisting dysglycaemia. The prevalence of undiagnosed T2D is high among hospitalized patients due to age and comorbidities. In a study of 40,836 in-hospital patients (19% with known diabetes), 47% underwent perioperative screening of

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