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Guidelines

Perioperative management of adult diabetic patients. Specific situations

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ABSTRACT

Ambulatory surgery can be carried out in diabetic patients. By using a strict organisational and technical approach, the risk of glycaemic imbalance is minimised, allowing the patients to return to their previous way of life more quickly. Taking into account the context of ambulatory surgery, with a same day discharge, the aims are to minimise the changes to antidiabetic treatment, to maintain adequate blood sugar control and to resume oral feeding as quickly as possible. The preoperative evaluation is the same as for a hospitalised patient and recent glycaemic control (HbA1c) is necessary. Perioperative management and the administration of treatment depend on the number of meals missed. The patient can return home after taking up usual feeding and treatment again. Hospitalisation is necessary if significant glycaemic imbalance occurs. In pregnancy, it is necessary to distinguish between known pre-existing diabetes (T1D or T2D) and gestational diabetes, defined as glucose intolerance discovered during pregnancy. During labour, blood sugar levels should be maintained between 0.8 and 1.4 g/L (4.4–8.25 mmol/L). Control of blood sugar levels is obtained by using a continuous administration of insulin using an electronic syringe (IVES) together with a glucose infusion. Post-partum, management depends on the type of diabetes: in T1D and T2D patients a basal-bolus scheme is restarted with decreased doses while in gestational diabetes insulin therapy is stopped after delivery. Antidiabetic treatment is again necessary if blood sugar levels remain > 1.26 g/L (7 mmol/L).

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1. Ambulatory surgery

The main elements are summarised in Practical sheet L.

Ambulatory surgery (AS) is a form of management that is becoming more common; in 2014, approximately 45% of surgical procedures in France were carried out in ambulatory conditions [1]. Although this figure is below that observed in several other industrialised countries, comparisons are difficult because, the definition of the duration of hospital varies between countries (≤ 12 h in France and < 24 h without spending the night in hospital in several other countries). Also terms such as day surgery, same-day surgery, day-case surgery, day-care surgery refer to a duration of stay ≤ 24 h while the term outpatient surgery should be used for a procedure performed under local anaesthesia without the need for specific postoperative observation [2].

The selection of patients for AS traditionally takes into account two main factors:

- the nature of the procedure with, essentially, the selection of interventions involving minor surgery, such as those identified by marker acts [3];
- the underlying terrain and co-morbidities, with frail patients or those with a high-risk disease, notably cardiac or respiratory, usually being excluded from AS.

Today, the recommendations of SFAR [4] do not put any barriers in place regarding these two criteria, considerably increasing the number of eligible patients.

Historically, diabetic patients have been declined AS for several reasons, including alterations of major organs, which increase the perioperative risk. The presence of diabetes treated with insulin is associated with an increase in the perioperative risk by 1 point according to the RCRI or Lee's score [5] with each change of 1 point having a quasi-exponential effect on the risk of cardiovascular morbidity during surgery. It was therefore considered that traditional hospitalisation was better tailored to these patients, allowing closer hospital observation and monitoring. It was also thought that the glycaemic imbalance in diabetics, occurring during the perioperative period would be better controlled by traditional hospitalisation. Today, the opposite view is taken and it is suggested that AS, by a closer organisational and technical approach, minimises the risk of glycaemic imbalance and allows patients to return to their previous living conditions quicker. Many diabetic patients (notably those with T1D) know how to effectively manage and control their own blood sugar levels at home postoperatively and maintain (or to rebalance) their glucose blood concentration.

Furthermore, visceral damage secondary to the disease is often associated with major surgery (cardiac surgery for example), yet vascular damage is also responsible for changes to other organs, such as the eye, where surgery suits the ambulatory patient.

There are relatively few recent studies assessing the management of diabetic patients in AS; we only found a single recommendation [6] and two studies assessing practices and published over the past five years [7,8]. Overall, the logical objectives in this situation are to maintain adequate glycaemic control and to avoid hypoglycaemia. Taking into account the context of this surgery, with return home the same day, it is logical to minimise the changes to antidiabetic treatment, to resume oral feeding as quickly as possible and to regularly monitor blood sugar levels. For Di Nardo et al. [7], the anaesthetist is the most competent person to guide management and to make the necessary changes to treatment.

1.1. Preoperative evaluation

The evaluation is the same as for a hospitalised patient. The criteria that may lead to surgery being declined or temporarily postponed depend on the surgical indication, on poor glycaemic control and/or on poor tolerance of diabetes. For example, recurrent thoracic pain or new EKG signs in the context of non-urgent surgery may lead to the surgical procedure being postponed and additional assessment of the patient being encouraged. Knowledge of the result of a recent HbA1c measurement will help to define the strategy. A value between 6 and 8% is reassuring about the quality of long-term treatment and the patient's compliance with treatment. Close observation and glycaemic control will help to avoid imbalance and the need for sudden hospitalisation. A value $< 6\%$ or $> 8\%$ may lead to a postponement of surgery or at least to a request for the advice of the referring physician.

If the diabetic has not had their HbA1c checked for several months, a review of prescribed medication may be necessary, as there is a correlation between the value for this parameter and the risk of complications in traditional surgery [9]. During the preoperative anaesthesia consultation, information about the current treatment is obtained. The patient is told that in the context of AS, treatment should not be modified (except if a longer duration of hospitalisation than normal is needed or if the patient does not immediately resume feeding). No specific premedication is required.

1.2. Perioperative strategy

The evening before AS, the patient takes his/her usual treatments and eats normally. Upon admission to the AS unit, a peripheral venous line is inserted but a glucose infusion is only necessary if resumption of oral feeding is delayed (see below). Care may be regulated according to the number of meals that the patient is going to skip.

In the majority of cases, a single meal (on the morning of admission) is missed. The patient may however drink clear fluids before hospital admission.

If surgery is short and the patient is transferred to the discharge room [after leaving the Post Anaesthesia Care Unit (PACU)] before 10 am, breakfast is served to the patient who takes his/her morning medication at that time. In this situation, it is accepted that there will be a small delay, but the usual routine of the patient is respected. Priority should thus be given to diabetic patients on the surgical list.

If leaving the PACU occurs later, between 10 am and noon, the patient should not take his/her usual medication in the morning before going to the hospital but take it on arrival at hospital and a glucose infusion is set up (G 10% 40 mL/h) on arrival in the AS unit. Infusion should be continued until the next meal if treatment includes insulin or an insulin secretor drug (sulphonamide or glinide).

If the patient is scheduled to leave the PACU even later (after 12:00), a light breakfast (including solids) is provided and medication is ingested before going to the hospital. A peripheral venous line is inserted, but a glucose solution is not necessary.

If surgery and anaesthesia are scheduled so that the patient does not miss a meal, treatment is continued and the patient has their breakfast as usual.

1.3. Glycaemic control

Capillary blood sugar levels are measured on arrival in the AS unit. A glycaemic objective between 5 and 10 mmol/L (0.9–1.8 g/L) is recommended. An insulin (ultra-rapid analogue) bolus is administered if the capillary blood sugar level is > 10 mmol/L (1.8 g/L). During the procedure, the blood sugar level is measured hourly, especially if surgery is lengthy.

If the blood sugar level is > 16.5 mmol/L (3 g/L), surgery is postponed and treatment with a corrective bolus is administered

with measurement of blood sugar levels every 2 h. If such treatment leads to a rapid control of the blood sugar level then surgery can be carried out. If glycaemic imbalance persists with blood sugar levels > 16.5 mmol/L (3 g/L), the patient should be admitted to hospital and IVES initiated.

1.4. Postoperative period

Oral feeding is resumed as soon as possible and repeated measurement of blood sugar levels continued.

If blood sugar levels are ≤ 10 mmol/L (1.8 g/L), the regular treatments are resumed at the usual times.

If blood sugar levels become > 10 mmol/L (1.8 g/L), the patient should remain in hospital and receive intermittent injections of corrective subcutaneous boluses until glucose levels decrease to 5–10 mmol/L (0.9 and 1.8 g/L).

If blood sugar levels become > 16.5 mmol/L (3 g/L), discharge home is contraindicated and the patient is dmitted to hospital in order to initiate IVES insulin therapy.

Overall, ambulatory surgery is possible in a diabetic patient and general rules of ambulatory anaesthesia are followed. Management of the diabetic patient depends on the number of meals missed. These strategies are summarised in practical sheet L.

2. Pregnancy and diabetes (practical sheet N)

2.1. Definition and physiology

During pregnancy, it is necessary to distinguish between known pre-existing diabetes and gestational diabetes.

2.1.1. Pre-gestational diabetes

T2D is now more common than T1D in pregnant women. These two types of diabetes are treated with insulin during pregnancy, possibly with a SC insulin pump (60% of T1D, 10% of T2D). From a physiological standpoint, blood sugar levels decrease in the first trimester and women may be subject to hypoglycaemia. Insulin resistance then occurs, the doses of insulin are increased up to 3-fold [10]. In women with T1D, there is a risk of ketosis, or even ketoacidosis, even when blood sugar levels are only moderately elevated [11]. Screening for ketosis should therefore be carried out if there are clinical signs even with blood sugar levels < 11 mmol/L (2 g/L), due to the risk of foetal death in the absence of treatment.

2.1.2. Gestational diabetes [12]

Gestational diabetes is defined as glucose intolerance discovered for the first time during pregnancy and which corresponds to two scenarios, either:

- hyperglycaemia generally occurring at or after the 24th week against a background of physiological insulin resistance (approximately 85% of cases);
- pre-diabetes or T2D existing before the pregnancy but ignored.

When blood sugar levels are very high during screening, we refer to "true diabetes discovered during pregnancy" (Appendix 1). Despite screening in the presence of risk factors, the prevalence of gestational diabetes increases regularly. For example, in France, it occurs in 8.3% of pregnancies, or approximately 50,000 pregnancies per year. Treatment initially is based on dietary measures associated with auto-observation of blood sugar levels 4–6 times a day and insulin therapy (20–30% of cases). The objectives are similar for all types of diabetes; fasting blood glucose < 5.2 mmol/L (0.95 g/L) and 2 h after a meal < 6.6 mmol/L (1.20 g/L).

2.2. Risks associated with diabetes during delivery

The risks of complications are higher for women with T1D, then T2D, than for those with gestational diabetes. Compared to patients without diabetes, the risks associated with caesarean delivery are increased 4.3-, 3.2- and 1.4-fold, respectively, and for eclampsia 6.6-, 4.0- and 1.6-fold. The neonatal prognosis follows an identical curve for macrosomia (vs. no diabetes, *OR* = 7.7, 3.8 and 1.8, respectively); with a risk of respiratory distress (*OR* = 2.1, 1.7 and 1.3, respectively). Perinatal mortality is increased in women with pre-gestational diabetes (*OR* = 3.6 for T1D and 1.8 for T2D), with an increased risk of perinatal mortality (*OR* = 1.3) when labour occurs after 37 weeks [13]. There is also a risk of neonatal hypoglycaemia, which is greater in women with poor glycaemic control during pregnancy and during labour, revealed by raised HbA1c [14–17]. Maternal hyperglycaemia induces foetal hyperinsulinism, which decreases 24 to 48 hours post-partum, while maternal carbohydrate supplies are stopped immediately after birth. The prevalence of neonatal hypoglycaemia is 10–40% and is even higher when infants are born from a mother with T1D, or when the neonates have macrosomia or in case of prematurity. The consequences, mainly of neurological origin, are related to the duration and severity of these neonatal hypoglycaemic episodes.

2.3. Glycaemic objectives during labour and delivery

The glycaemic objectives during labour are determined in relation to the risk of neonatal hypoglycaemia. Objectives (3.8–6 mmol/L [0.7–1.10 g/L]) have been described in the recent Guidelines from the American College of Obstetricians and Gynaecologists and the National Institute for Health and Care Excellence [11]. Similarly, the SFD recommends obtaining blood sugar levels that are close to normal [18].

Earlier studies have shown variable results regarding the absence of neonatal hypoglycaemia when a strict glycaemic control is achieved in the mother during labour [19,20]. Neonatal hypoglycaemia can indeed occur even when maternal blood sugar levels are controlled during labour. In a retrospective study of 197 women with T1D, 46% of neonates had hypoglycaemia and there was no correlation between neonatal and maternal blood sugar levels when the latter were maintained between 4 and 8 mmol/L (0.72–1.44 g/L). Conversely, there was a significant negative correlation between neonatal and maternal blood sugar levels when the latter were > 8 mmol/L (1.44 g/L) [16]. By using a continuous glucose monitoring system in order to adapt insulin therapy to maintain blood sugar levels between 0.8 and 1.5 g/L (4.4 and 8.25 mmol/L), one group reported the absence of hypoglycaemia [21]. We thus propose the same glycaemic objectives as those proposed by Lepercq et al., i.e. maternal blood sugar levels between 0.80 and 1.40 g/L (4.4–8.25 mmol/L) [15].

2.4. Actions to be taken

Practical sheet N describes actions to be taken for the three types of diabetes during the three different phases of childbirth.

2.4.1. During dilation of the cervix

The treatment for each type of diabetes is continued as during pregnancy with the same glycaemic objectives.

2.4.2. During delivery

2.4.2.1. Insulin therapy. In patients with T1D or T2D, and those with gestational diabetes with blood sugar levels > 8.25 mmol/L (1.40 g/L) IVES insulin will take over insulin injections during labour or caesarean section, and will be continued until return to

the PACU. In women treated using a SC insulin pump, it is preferable to change to IVES treatment. Retention of the insulin pump during labour is possible but requires a personalised protocol for adaptation of the insulin pump output during labour. There is a high risk of ketosis if insulin therapy is interrupted in a patient with T1D. In the case of gestational diabetes, IVES insulin will only be used if the glycaemic objective is not obtained (glycaemia > 1.40 g/L or 8.25 mmol/L).

2.4.2.2. Glucose infusion. Labour is a state requiring the consumption of energy during the active phase, expulsion and when duration is prolonged. Patients treated with insulin require glucose (10%) infusion to avoid maternal hypoglycaemia and ketosis due to fasting.

2.4.3. Immediate post-partum

After birth, the course of action depends on the type of diabetes. Anticipation is necessary and the protocol planned using a document written by a diabetologist (Appendices 2 and 3).

The glycaemic objectives are not as strict after labour, with a proposed range between 6 and 8.8 mmol/L (1.10–1.60 g/L) after vaginal delivery and slightly lower after a caesarean section, to support wound healing [11].

If the protocol is not defined, the principles for the management of diabetes are as follows:

- in T1D: resume the basal-bolus insulin scheme, with a decrease in dose of insulin (either 80% of the doses used before pregnancy or 50% of the doses at the end of pregnancy). Doses of insulin will indeed have to be doubled or tripled during the pregnancy [10]. It should be remembered that T1D patients are usually autonomous in the management of their diabetes and that basal slow insulin should never be stopped. When the electronic syringe is stopped, slow insulin should immediately be resumed if the last injection has been administered > 24 h ago (if slow insulin is injected once a day). If the patient is on an insulin pump, it should be restarted as soon as the electronic syringe is stopped;
- in insulin-treated T2D: insulin is continued at half-dose while awaiting the advice of a diabetologist;
- in gestational diabetes: insulin is stopped. Monitoring of blood sugar levels before and 2 h after a meal is continued for 48 h. Treatment should be discussed with a diabetologist if fasting blood sugar levels are > 1.26 g/L (7 mmol/L) and post-prandial blood sugar levels are > 2 g/L (11 mmol/L).

Disclosure of interest

The authors declare that they have no competing interest.

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Appendix 1. Screening for gestational diabetes

Early screening for dysglycaemia is recommended in women at risk by measuring the fasting blood sugar level (FBS). If early screening is normal, screening is carried out after 24 weeks (when insulin resistance increases) after an oral glucose load of 75 g.

Risk factors

Body mass index (BMI) ≥ 25 kg/m^2

Age ≥ 35 years

Personal history of gestational diabetes

1st degree family history of T2D

History of macrosomia (big baby)

First trimester: fasting blood sugar (FBS)

Indication: women with at least 1 risk factor

FBS < 0.92 g/L (5 mmol/L): normal; screening between 24 and 28 weeks after oral loading with 75 g glucose

Between 0.92 and 1.25 g/L (5–6.9 mmol/L): start gestational diabetes management

FBS ≥ 1.26 g/L (6.9 mmol/L): true diabetes discovered during pregnancy

Second trimester: hyperglycaemia provoked by oral loading with 75 g glucose

Indication:

Woman with a risk of FBS < 0.92 g/L (5 mmol/L) in the first trimester

Women without any risk factor but presenting with macrosomia on ultrasound assessment

Interpretation of result:

Gestational diabetes:

If FBS is between 0.92 g/L and 1.25 g/L (5–6.9 mmol/L)

and/or blood sugar levels 1 h (G1 h) after loading ≥ 1.80 g/L (10 mmol/L)

and/or blood sugar levels 2 h (G2 h) after loading between 1.53 and 1.99 g/L (8.4–11 mmol/L)

Recognised decompensated diabetes during pregnancy:

FBS ≥ 1.26 g/L (6.9 mmol/L)

and/or G2 h ≥ 2 g/L (11 mmol/L)

Appendix 2. Model of communication form for post-partum management

Communication document for post-partum management
DIABETOLOGIST-PATIENT-MATERNITY

Name, First name of patient:

Type of diabetes:
(DT1, DT2, gestational, other)

Treatment at the end of pregnancy:
(Dietary only/insulin scheme, dose)

Immediate post-partum

- Insulin therapy ☐ To be continued ☐ Stop and observe

Scheme and dose of insulin to resume after stopping the insulin electronic syringe (DT1 and DT2):
In D1T diabetes, basal insulin should never be stopped, risk of ketoacidosis++

*Insulin slow (long-acting):

*Ultra-rapid analogue:

*Pump (basal and bolus):

- Oral antidiabetic drugs: ☐ **YES** ☐ **NO**

Type 2 diabetes, without breast-feeding

Type, dose

- Observation of capillary blood sugar levels

(Frequency, objectives)

☐	Waking	0.80 to 1.60 g/L	☐	Post-prandial	< 1.80 g/L
☐	Pre-prandial	0.80 to 1.60 g/L	☐	Sleeping	< 1.80 g/L

- Diabetological evaluation recommended before discharge ☐ YES ☐ NO

- Post-partum consultation

☐ Consultation with a diabetologist in 2-3 months:
☐ Consultation with the treating physician in 2-3 months
☐ Other:

- Assessments to prescribe at this consultation

☐ HbA1c
☐ Fasting blood sugar
☐ Blood sugar levels 2 h after oral loading with 75 g glucose

Appendix 3. Practical sheet for intrapartum observation

Diabetes – Hourly monitoring

Name: ……. **Date:** ……./……./…….

Time (hr)	D10%W (mL/h)	Ultrarapid insulin (IU/h)	Capillary blood glucose (g/L or mmol/L)	Ketonaemia or ketonuria	Comments

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