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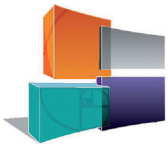

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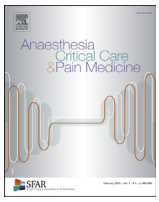

Editorial

Perioperative glycaemic control

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This special issue of *Anaesthesia Critical Care and Pain Medicine* is dedicated to the perioperative management of patients with diabetes and includes updated recommendations for daily clinical practice. These practical recommendations [1–3] are clearly mandatory and will be very useful.

Historically, the interest for perioperative glycaemic control started after consistent reports of high prevalence of wound infections after heart surgery in case of poorly controlled diabetes mellitus. These clinical observations paved the way for the implementation of postoperative insulin therapy for glycaemic control [4] and were used later to support the studies on tight glycaemic control in intensive care.

In 2018, the selection of the perioperative care of patients with diabetes mellitus is definitely timely and highly relevant for three reasons, at least:

- the incidence of type 2 diabetes mellitus (T2DM) is rising in the Western world as well as in developing countries, for multiple reasons mainly related to changes in lifestyle, lengthening of lifespan and life expectancy related to the medical progresses and genetic background (ref 2 = txt 1) [5,6]. A recent report of the available literature estimated that there were 415 million people with diabetes aged 20–79 years worldwide, i.e. a multiplication by a factor 4 of the incidence reported in 1980 [7]. The population of patients with diabetes requiring surgery is probably rising even more rapidly, thereby representing a major challenge to be daily faced by anaesthesiologists;
- some confusion around the management of stress hyperglycaemia and the interpretation of stress hyperglycaemia resulted from the controversial results of recent interventional studies performed in intensive care [8,9]. Of note, insulin resistance underlies the pathophysiology of stress hyperglycaemia and T2DM. However, unlike T2DM, stress hyperglycaemia is associated with a partial loss of the inhibition of endogenous glucose production by an exogenous glucose load [10]. Also contrasting with T2DM, stress hyperglycaemia can be considered as an evolutionary preserved adaptive response to a major stress [10,11]. Regardless of the pathophysiology, the risks of tolerating severe and sustained hyperglycaemia must be balanced against the benefits of preserving an adaptive mechanism, underlying the selection of intermediate glycaemic targets [12]. The interpretation of clinical research in this area is complicated by several factors including discrepancies in the operational definition of stress hyperglycaemia. In contrast to the definition suggested by the American Diabetes Association (blood-glucose levels $\geq$ 180 mg/dL (10 mmol/L), with levels returning to normal ($<$ 126 mg/dL or 7 mmol/L) after removal of the stressor and withdrawal of glucose-lowering treatment) [6], we found in a recent scoping review on data reported from more than 536,000 patients the definition of stress hyperglycaemia ranging from 100 mg/dL (5.6 mmol/L) to 300 mg/dL (16.7 mmol/L) [13]. In spite of these discrepancies, there was a consistent association between stress hyperglycaemia and worsened outcomes. In fact, each of the 3 domains of dysglycaemia (hyperglycaemia, hypoglycaemia and high variability) was associated with poor outcome in critically ill patients [14,15];
- the outcome of patients undergoing scheduled surgery was improved by the use of "Enhanced Recovery After Surgery" programs aiming at an improvement of insulin sensitivity (a decrease in insulin resistance). This multimodal approach includes minimally invasive surgery, pain management focused on opioid-sparing interventions through the use of multimodal analgesia, early mobilisation and ambulation within 12 hours of surgery completion, avoidance of prolonged perioperative surgical fasting through the use of a preoperative high-carbohydrate beverage within 2 to 4 hours and/or solids within 8 to 12 hours before surgery and early postoperative nutrition was provided within 12 hours after surgery [16].

Clinical recommendations issued and deducted from the numerous recent clinical findings were probably hard to develop. The strength of evidence supporting these recommendations is often weak, implying that these could be changed by the publication of new data, resulting from future progresses.

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Hopefully, our understanding of the pathophysiology of stress hyperglycaemia should be refined and the management of perioperative glycaemic control could be improved by technological advances, allowing individualisation of treatments. Among potential future developments, the use of estimated average blood glucose calculated from baseline glycosylated haemoglobin, as therapeutic target is very appealing from a pathophysiological viewpoint, as well as from recent clinical findings [17,18]. The use of estimated average BG to define an individualised BG target and to reach it via therapeutic algorithms has been assessed in the unpublished multi-centre prospective French Controlling (CONTRÔLe INdividualisé de la Glycémie en reanimation) study (clinicaltrials.gov NCT02244073). Other improvements could result from near-continuous glucose monitoring, as improving the safety of glycaemic control [19]. The use of intravascular monitoring is probably needed in the acutely ill, unstable patient, while during recovery or for transitioning to non-acute wards interstitial near-continuous glucose monitoring could be used. Finally, closed-loop systems coupling a continuous glucose monitoring to an insulin pump whose infusion rate will be regulated by a computerised algorithm able to mimic the endocrine pancreas [20,21].

In any case, despite lows and heights, regardless of some disappointments generated by some clinical studies, the story of glycaemic control in acutely ill patients is definitely not over [22].

Disclosure of interest

Jean-Charles Preiser received fees for consultancy from Edwards, Medtronic and Optiscan.

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