In 1979, the British Journal of Anaesthesia published an article by Alberti and Thomas in which they introduced the i.v. infusion of a premixed bag of glucose–insulin–potassium for the metabolic management of diabetic patients in the perioperative period. The Alberti regimen has been superseded in many centres by the use of separate infusions of insulin (usually 1 U ml\(^{-1}\)) and glucose with or without potassium. Although the separate infusions offer greater flexibility, they lack the inherent safety of the combined regimen.

The article reviewed the management of diabetic surgical patients in detail, in addition to the description of the Alberti regimen, and it is apposite to re-examine this seminal paper when there is great interest currently in glucose control in surgical patients, both diabetic and non-diabetic. In their introductory remarks, Alberti and Thomas noted the need for a logical and straightforward set of guidelines for treating diabetic patients during and after surgery and that many of the regimens recommended in 1979 were irrational if not dangerous. It is to be hoped that 30 yr later, the current guidelines are both logical and safe, but there is little evidence to support the regimens described in standard anaesthetic textbooks.

The authors discussed first the normal endocrine and metabolic response to starvation and surgery and then how this may be modified in the diabetic patient. They commented that starvation was generally the fate of the surgical patient, despite the best intentions of the clinicians. Although there have been undoubted improvements in decreasing the duration of preoperative starvation, postoperative starvation has not received the same attention in many centres. The detailed description of the metabolic changes occurring in starvation is striking even 30 yr later and it is regrettable that this key knowledge is still lacking in some clinicians managing surgical patients. Alberti and Thomas emphasized that during starvation in type 1 diabetics, the restraining effects of basal insulin on catabolism are lost and that catabolism ‘runs riot’ when catabolic hormone secretion increased during surgery. The provision of insulin with sufficient carbohydrate, \(~180 \text{ g day}^{-1}\), was necessary to mitigate uncontrolled catabolism.

The description of the metabolic response to surgery was also comprehensive and it is only in the section on the effects of anaesthesia, where diethyl ether and chloroform are mentioned, that the lack of an anaesthetic co-author is apparent. By 1979, anaesthetic techniques such as extensive neuraxial block and high-dose opioid anaesthesia had been shown to reduce the catabolic hormonal response to some surgical procedures with a consequent decreased hyperglycaemia. It had been suggested that these techniques may be appropriate for patients with metabolic problems such as diabetes.

Alberti and Thomas summarized the aims of treatment of diabetes as the rapid recovery from surgery with minimal metabolic problems, such as hypoglycaemia and ketoacidosis, and minimal complications such as infection, delayed wound healing, and cardiovascular events. These aims are equally appropriate in 2009 and it is only when the authors state that it is beneficial, if not obligatory, for the diabetic patient having anything but the most minor surgery to be admitted to hospital 24–48 h before the operation for assessment and stabilization, that the reader is reminded that the article was published in 1979. The authors included original experimental data in the review article to support their recommendations, some of which were published in more detail in 1984. The thoroughness of their investigation of diabetic patients undergoing surgery was shown by the measurement of circulating glucose, NEFA, 3-hydroxybutyrate, pyruvate and lactate concentrations, and plasma and urinary electrolyte and urea values for up to 72 h after surgery.
The recommendations for managing type II diabetic patients were based on a comparison of the glucose-insulin-potassium regimen with no therapy. They concluded that there was improved metabolic control with the Alberti regimen in all diabetic patients treated with oral hypoglycaemic drugs except in those well-controlled patients undergoing minor surgery. It was recommended that long-acting sulphonylureas, such as chlorpropamide, should be stopped at least 3 days before surgery and biguanides also discontinued because of the risk of lactic acidosis. A recent evaluation of metformin indicated that the problems of lactic acidosis may have been exaggerated, and the inadvertent failure to stop metformin before cardiac surgery did not increase mortality and morbidity.

In type I diabetic patients, four regimens were examined: no insulin–no glucose, insulin s.c. with glucose i.v., combined regimen for up to 24 h, and combined regimen for 72 h. The no insulin–no glucose regimen failed to control glucose adequately and was associated with a marked increase in circulating NEFA and ketone body concentrations, raised urea excretion, and markedly negative potassium, phosphate, calcium, and magnesium balances. These results emphasized the importance of examining markers of lipid and protein metabolism and also blood glucose when assessing metabolic control in diabetic patients. Short-term starvation in an unstressed type 1 diabetic may be associated with a decrease in blood glucose but this is at the expense of enhanced catabolism. The regimen of insulin s.c. followed by an infusion of glucose i.v. was no better than no glucose–no insulin. The continuous infusion regimens provided the best metabolic control with stable blood glucose values, low circulating ketone body concentrations, and improved nitrogen and potassium balances. The recommendations for type I diabetic patients were to use the Alberti regimen in all patients undergoing surgery and to continue the infusion until the patient was eating (ambulatory surgery was in its infancy in 1979).

Practical aspects of the use of the combined regimen were discussed in detail. There were concerns that a variable quantity of insulin would be adsorbed to the plastics in the infusion bag and giving set but the authors found that the loss of insulin was only 10–28% which they considered acceptable. The use of a separate concentrated insulin infusion was being investigated at this time after its success in acceptable. The use of a separate concentrated insulin infusion bag and giving set but the authors found that the loss of insulin was only 10–28% which they considered acceptable. The use of a separate concentrated insulin infusion was being investigated at this time after its success in

The use of urinary ketones before surgery, once or twice during surgery, and 2–3 hourly until the patient was eating. The use of urinary glucose values to guide treatment was summarily dismissed as a ‘security blanket by the nervous and ignorant’ because the values were retrospective, insensitive and urine may be unavailable. Plasma potassium concentrations were also measured regularly, about half as frequently as blood glucose. Several factors were noted to increase insulin requirements: the severity of surgery, particularly cardiac surgery, the presence of an infection, and the administration of glucocorticoids and catecholamines. The problem of obesity with concomitant insulin resistance was recognized and it was recommended that if the diabetic patient was more than 50% heavier than their ideal body weight, then the dose of insulin should be increased two-fold.

The standard i.v. fluid in the Alberti regimen was glucose 10% infused at a rate of 100 to 125 ml h⁻¹. The risk of hyponatraemia from the prolonged infusion of glucose solutions is now well recognized. The authors stated that sodium chloride solution 0.9% was an acceptable fluid for i.v. use in diabetic patients but that lactate-containing solutions such as Hartmann’s solution should be avoided. The evidence to support the contention that lactate-containing solutions should not be used because they enhance the glycaemic response to surgery is very weak and was reviewed recently. If the volume of glucose solution i.v. needed to be restricted, for example, to give sodium chloride 0.9%, then the use of 20% or 50% glucose infused centrally was recommended.

The review ended with an Appendix that was a recipe of guidelines for the care of diabetic patients during and after surgery. The paper ended with ‘Special Notes’ which included the following advice that is still highly relevant today:

Continuous therapy. If the infusion stops, the patient’s ECF will contain no effective insulin within 30 min. Therefore, ensure that therapy is continuous.

Normoglycaemia. Aim to maintain blood glucose between 5 and 10 mmol l⁻¹.

Common sense. These are guidelines. The starting regimen (10% glucose 500 ml;insulin 10 units+KCl 1 g) is based on experience and a comparative study, but it is not meant to be unthinkingly adhered to. Patients will always vary, so therapy must be flexible and common sense applied.

After 30 yr, this article still has the sparkle of a precious gem; it contains the science, practical details, and wisdom necessary to manage surgical diabetic patients successfully. Close reading of the text should be obligatory for all anaesthetists and intensivists. Without doubt it is a citation classic.

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