published as a case report, was a 63 yr old man undergoing an elective open hepatic resection, following neoadjuvant chemotherapy to treat liver metastases secondary to colonic cancer. The patient’s comorbidities included hypertension, hypercholesterolaemia and non-insulin dependent diabetes, for which he took metformin, bendroflumethiazide, doxazosin, nicardipine and simvastatin. Importantly he had a normal preoperative renal function (Serum Creatinine 87 μmol litre$^{-1}$ and eGFR>60 ml min$^{-1}$), and his diabetes was well controlled (HbA1c 6.9%, Preoperative BM 4.2). He was admitted the evening before his surgery, was nil by mouth from midnight, did not receive overnight fluid replacement (as per local protocol) and received all of his regular medication, including metformin on the day of surgery. Through the course of his 6.5h procedure the patient developed a worsening lactic acidosis, with his final arterial blood gas demonstrating pH 7.17, BE −11.6 mol litre$^{-1}$ and Lactate 9.1 mmol litre$^{-1}$. This has been attributed to a combination of metformin, and fluid restriction as per local policy in an attempt to reduce central venous pressure and thus reduce operative blood loss via back bleeding from the hepatic veins. The patient required a 15 day Intensive Care stay, where he received renal replacement therapy and inotropes before ward step down.

Although thankfully remaining an uncommon event, when it does occur metformin-associated lactic acidosis is a serious complication. We believe that patients such as this are important reminders that certain patient groups taking metformin, in the face of an iatrogenic starvation period, may still be at increased risk of developing this complication, even if they have previously normal renal function and are not receiving any i.v. contrast. We would advocate that cessation of metformin therapy on the day of surgery remains a prudent measure for diabetic patients undergoing liver resection surgery.

**Declaration of interest**

None declared.

**References**

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**Perioperative management of diabetic patients: new controversies**

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Editor—We read with interest the editorial by Aldam, Levy and Hall.1 We agree with the authors that with new research evidence, it is important that guidelines for perioperative management of diabetic patients must evolve quickly to reflect this.

However, we cannot help but think that we are still missing the ‘elephant in the room’ here.

The evidence supporting good glycaemic control in reducing perioperative complications is undeniable and most clinicians, if not all, would agree with this. However, as the authors themselves had highlighted - ‘the devil is in the details’. Glycated haemoglobin (HbA1C) is a good indicator of preoperative glycaemic management. However, the only way to assess a patient’s intra and postoperative glucose control is to do regular, serial blood glucose measurements. It should be emphasized that this is an invasive procedure, albeit minimally so.

The current NHS guideline recommends at least hourly blood glucose measurement throughout the perioperative period. This is based on expert opinion and popular practice with limited scientific evidence to support. We are of the opinion that this is neither practical, nor is it necessary for all diabetic patients. No doubt, hourly glucose measurements are indicated for some but it is extremely labour intensive to measure blood glucose hourly for everyone, and with the prevalence of diabetes projected to increase, this practice is unsustainable.

A local departmental audit in our hospital two yr ago confirmed that more than a third of our patients on insulin did not have hourly blood glucose measurements intra-operatively. We believe this is a similar story for many NHS Trusts across the country as well.

The barrier to improving perioperative glycaemic control is not ignorance of its importance, but the tedious process and practicality of achieving this goal. We think that an impractical guideline leads to haphazard individualized practice amongst clinicians, including some who might choose to ignore intra-operative glucose monitoring completely. We propose the use of a simple risk stratification system of patients based on the risk of hypo and hyper-glycaemia, to guide the frequency of serial blood glucose measurements. For example, patients with diabetes who are not usually on insulin therapy, a blood glucose measurement immediately pre-induction of anaesthesia followed by 2-h intra-operative monitoring may suffice.

At Addenbrooke’s Hospital in Cambridge, a recent transformation to electronic patient medical records has enabled us to build in an automated system to remind the anaesthetist at preset intervals of the need for regular intra-operative glucose measurements. An abstract by Ehrenfeld and colleagues2 introducing a similar reminder system showed a small but statistically
significant reduction in length of recovery stay and 14-day re-admission rate, probably as a result of better glucose control. We accept that this is only an abstract evidence but it does support the idea that improving glucose monitoring compliance may lead to improvement in glucose control.

Future research should consider the optimal frequency of glucose measurement and novel techniques to do so. Until we successfully tackle the very practical issue of how to monitor glucose effectively, achieving good perioperative glycaemic control in our patients may remain a utopic dream.

Declaration of interest
None declared.

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Reply from the authors
Perioperative management of diabetic patients: new controversies—authors’ reply
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Editor—We appreciate the chance to respond to the letters by both Evans and colleagues and Quak and colleagues in response to our recent editorial.1 The letter by Quak and colleagues suggests that we should not be measuring capillary blood glucose hourly in our anaesthetised patients. First, we never discussed the frequency of measurement, but second, and more importantly, their proposal may lead to patient harm. The National Diabetes Inpatient Audit demonstrates that ~50% of patients with type 1 diabetes mellitus experience at least one episode of hypoglycaemia per hospital stay.2 Hypoglycaemia in the sedated patient population leads to patient death, as demonstrated by the multicentre Normoglycemia in Intensive Care Evaluation–Survival Using Glucose Algorithm Regulation (NICE-SUGAR) study.3 Reducing the frequency of capillary blood glucose monitoring can only lead to patient harm.

The letter by Evans and colleagues attributes their patient’s severe perioperative lactic acidosis to continuation of metformin, and they subsequently suggest that metformin should be withheld in all patients undergoing liver resection surgery. Metformin is a biguanide similar to phenformin. Phenformin was withdrawn from the market in the 1970s due to its association with lactic acidosis, and subsequently metformin has been tarnished by its class rather than scientific data.4 Lactic acidosis occurs in patients with type 2 diabetes more frequently than in the general population, and the incidence is the same with all oral hypoglycaemic agents.5–6 Furthermore, when patients on metformin do develop lactic acidosis, metformin levels and lactate levels do not correlate.7–8 Finally, metformin levels are not linked to mortality in those who develop lactic acidosis. This suggests that it is other factors that are more important in the development of acidosis.7–9 The patient described by Evans and colleagues appears to have had profound intraoperative hypotension and hypovolaemia, and either of these factors, rather than the metformin, might have precipitated the lactic acidosis in their diabetic patient who had had extensive chemotherapy.

Due to the common and unfounded practice of withholding metformin perioperatively, there is therefore legitimate concern that the benefits of metformin are being withheld to patients who could benefit from continued perioperative metformin use. In 2005, in light of the unproven causative link between metformin and lactic acidosis, Holstein and colleagues published their aptly titled paper ‘Contraindications can damage your health—is metformin a case in point?’10

Declaration of interest
N.L. has received travel expenses to attend the National Health Service Diabetes meeting.

References