

Perioperative management of the patient with diabetes requiring emergency surgery

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Key points

- About 100 000 emergency surgical procedures are performed per annum in the UK on patients with diabetes. Diabetes is a recognized factor for a patient to become the higher risk surgical patient.
- The emergency surgical patient with diabetes requires meticulous initial assessment and planning to allow the diabetes, the diabetes medication and any other associated comorbidity to be optimally managed. A number of modifiable risk-factors have been identified, and by optimizing these modifiable risk factors, outcomes can be improved.
- For the majority of patients, the variable rate i.v. insulin infusion (VRIII) is required to control the diabetes and maintain optimal glycaemic control of 6–10 mmol litre⁻¹. When and where possible, the patient with diabetes requiring expedited surgery should be managed by simple manipulation of their diabetes medication.
- The goal of the intraoperative care/anaesthetic technique is to promote early resumption of eating and drinking and return to normal medication, whilst simultaneously preventing morbidity from glycaemic variability, acute kidney injury (AKI), fluid, and electrolyte imbalance amongst other complications.

Diabetes is the most common metabolic disorder, affecting at least 6–7% of people in the UK. The most recent data from the National Diabetes Inpatient Audit showed that in 2013 the prevalence of diabetes in the UK in-patient hospital population ranged from 10 to 35%.¹ Diabetes-related co-morbidities increase the need for surgical and other operative procedures, thus at least 10% of patients undergoing emergency surgery have diabetes. Diabetes leads to increased morbidity, mortality, and increased length of stay whatever the admission specialty, thereby increasing costs of inpatient care.² The perioperative mortality rate for people with diabetes is reported to be up to 50% higher than the non-diabetic population,³ the reasons being multifactorial,⁴ many of which are modifiable. Thus the emergency surgical patient with diabetes is often classified as being high risk. Articles have been published in an effort to improve the outcome of the elective surgical patient with diabetes^{4,5} with the emergency surgical patient with diabetes being largely ignored. The purpose of this article is to redress that balance.

Potential reasons for patients with diabetes having higher perioperative morbidity and mortality rates after emergency surgery

The emergency surgical patient with diabetes is recognized to be at higher risk of complications. This is due to a number of factors including:

Multiple co-morbidities

Patients requiring emergency surgery with diabetes will often have co-existing microvascular and macrovascular

complications, and then by definition will often have an ASA grade of risk of at least grade IIIE. The immediate/urgent emergency surgical patient with diabetes should always have their comorbidities assessed and any necessary precautions and actions taken to prevent deterioration. This may involve critical care, or other specialists e.g. cardiologists if the patient has an implantable cardioverter defibrillator. Furthermore, recent papers^{3,6} have demonstrated a significant association between perioperative hyperglycaemia and the medical and infective complications of surgery [e.g. acute kidney injury (AKI), acute coronary syndromes, cerebro-vascular accidents, wound infections, and systemic infections]. These data provide impetus to ensure glycaemic control between 6.0 and 10.0 mmol litre⁻¹.

Peri-operative infection

It is widely recognized that the surgical patient with diabetes has an increased risk of surgical site infection (SSI). It is also becoming increasingly recognized that diabetes and the degree of perioperative glycaemic control is a risk factor for both SSI and systemic infections.^{3,6} Most authorities therefore suggest that glycaemic control throughout the whole of the hospital stay should be kept between 6.0 and 10.0 mmol litre⁻¹,⁴⁻⁷ and this target zone should be aimed for during surgery.

Hypo- and hyperglycaemia

Hyperglycaemia [defined as a capillary blood glucose (CBG) >10 mmol litre⁻¹] is associated with excess morbidity and mortality caused by SSI, systemic infections, and other medical complications.^{3,6} Conversely, hypoglycaemia (as defined as CBG <4 mmol litre⁻¹) is associated with excess mortality and extra length of stay. Worryingly, this excess mortality is now being observed in patients once their CBG is <6 mmol litre⁻¹.⁸ It is therefore vital that in-patients with diabetes have the frequency of blood sugar monitoring and the treatment of hypoglycaemia and hyperglycaemia prescribed on admission. Furthermore about 22% of in-patients with diabetes will suffer at least one episode of hypoglycaemia during their hospital stay.^{1,2}

Diabetic ketoacidosis and hospital acquired diabetic ketoacidosis

Patients may present to hospital with diabetic ketoacidosis (DKA) secondary to surgical pathology and may subsequently require emergency surgery. Additionally, DKA from other causes may mimic the acute abdomen and may lead to unnecessary emergency surgery.

Lack of administration of insulin to in-patients with Type 1 diabetes mellitus will result in hospital acquired DKA, and approximately 0.6% of in-patients with diabetes develop this preventable condition.¹ Hospital acquired DKA in a recent national survey was the third leading precipitant of DKA (7.8%), with the two leading causes being infections (44.6%) and non-compliance (19.7%).⁹

Misuse of variable rate i.v. insulin infusion

For many emergency surgical patients with diabetes, their glucose control is managed by the variable rate i.v. insulin infusion (VRIII) previously known as 'the sliding scale'. The premise is that the patient receives a constant supply of substrate (usually 5 or 10% dextrose at approximately 100 ml h⁻¹), and simultaneously receives an i.v. insulin infusion which is titrated to the

CBG levels, and hence theoretically the CBG is controlled. Prior to its introduction the VRIII was never subjected to rigorous safety/efficacy studies, and only now is the level of harm associated with the VRIII being recognized.^{1,2} Strategies that either limit the unnecessary use of the VRIII or make the use of the VRIII safer are intrinsic to the goal of reducing complications associated with the management of emergency surgical patient with diabetes.

Insulin prescribing

It is now recognized that while insulin has the potential to be lifesaving, it also has the potential to cause harm and death through careless prescribing and administration.¹⁰ Harm from insulin mis-prescribing/maladministration is now classified as one of NHS England's 'Never Events'.

There are nearly 100 types of insulin/insulin delivery devices in the UK, and it is essential that the brand name is prescribed, accurately stating the amount of insulin to be administered in units (with the word 'units' written in full), and that the times of administration are unambiguously recorded. The administering nurse must ensure that the insulin is administered correctly, and always use a dedicated insulin syringe.

It is becoming increasingly recognized that the paternalistic approach to in-patient healthcare can be detrimental, and when and where possible patients with diabetes should be encouraged to self-medicate.¹¹

Complex polypharmacy

Patients with diabetes are often prescribed several medications and the potential for either significant drug interactions or side effects is very real,^{1,2} e.g. an elderly patient with diabetes who has a fractured neck of femur and taking ramipril. The patient could develop AKI as a result of the administration of nephrotoxic drugs e.g. aminoglycosides, non-steroidal anti-inflammatory agents or due to deleterious effect of the ramipril being compounded by the low output state caused by either blood loss or intra-operative hypotension. The medical team need to be aware of these issues, and either takes precautions to ensure harm does not occur, or be vigilant and treat early and appropriately.

Complex fluid and electrolyte requirements

Repeated National Confidential Enquiries into patient outcome and death (NCEPOD) studies have demonstrated that fluid and electrolyte mismanagement is common in both the elective and emergency surgical patient and is a major cause of morbidity and mortality. Subsequently the National Institute for Health and Care Excellence (NICE) was commissioned to create guidance in order to improve fluid and electrolyte management of in-patients.¹² The surgical patient with diabetes requiring emergency surgery is at higher risk of AKI¹³ and fluid and electrolyte complications due to:

- (i) Co-morbidity e.g. pre-existing renal and cardiac impairment.
- (ii) Polypharmacy including nephrotoxic agents; diuretics and drugs causing electrolyte disturbances including insulin.
- (iii) Use of the VRIII demanding the use of concurrent substrate solutions containing glucose which predispose to hyponatremia.
- (iv) Use of the VRIII promoting intracellular potassium uptake and predisposing to hypokalaemia.

Development of pressure ulcers

The patient with diabetes is at risk of developing pressure ulcers, which may lead to extra morbidity and prolonged length of stay.⁴

Nature of emergency lists

For many years, the emergency operating list has been run by non-consultants and patients are operated on in the order of being 'booked', unless the patient requires immediate surgery. This has major repercussions including:

- (i) Unknown time of surgery with major delays and postponements.
- (ii) Prolonged and unpredictable starvation periods prior to surgery.
- (iii) Variable length of anaesthetic and surgical time due to lack of seniority of surgical and anaesthetic staff.
- (iv) Variable utilization of 'fast track' surgical and anaesthetic techniques that promote prompt eating, drinking, and mobilization.
- (v) Inability to utilize the standard comprehensive care pathway for management of the elective patient with diabetes purely due to the above reasons, resulting in reliance on the VRIII to manage the excessive period of starvation.

The burden of emergency surgery

In 2013 a snapshot survey in the UK estimated that 3 236 300 anaesthetics were administered by anaesthetists, with 965 100 being emergency procedures.¹⁴ Therefore, it can be estimated that at least 100 000 emergency surgical procedures are performed on patients with diabetes each year (taking the conservative estimate that 10% of the emergency surgical population has diabetes). The snapshot survey also examined the classification of emergency performed using the NCEPOD classification.¹⁵ These data and the extrapolated caseload (assuming that 10% of the emergency surgical population has diabetes) is shown in Table 1.

NCEPOD's classification of emergency surgery

Immediate

Immediate life, limb or organ-saving intervention—resuscitation simultaneous with intervention. Normally within minutes of the decision to operate.

Table 1 Estimated annual caseload of emergency procedures using NCEPOD classification

	Number of patients requiring emergency surgery	%	Approximate number of patients with diabetes (assuming approximately 10% prevalence of diabetes in the population requiring emergency surgery)
Immediate	85 800	9	9 000
Urgent	680 400	70	70 000
Expedited	198 900	21	20 000
Total	965 100		99 000

Urgent

Intervention for acute onset or clinical deterioration of potentially life-threatening conditions, for those conditions that may threaten the survival of limb or organ. Normally within hours of decision to operate.

Expedited

Patient requiring early treatment where the condition is not an immediate threat to life, limb or organ survival. Normally within days of decision to operate.

Elective

Intervention planned or booked in advance of routine admission to hospital. Timing to suit patient, hospital, and staff.

The care pathway for the emergency surgical patient

It is now becoming increasingly recognized that having definitive patient pathways leads to improved patient outcome in the elective surgical patient. The care pathway for the perioperative management of the emergency surgical patient is more complicated than the linear elective pathway purely because there are several ways for the patient to commence the journey. The pathway is summarized in Figure 1. Despite the complexity of the admission process, Figure 1 highlights the opportunities for anaesthetists to influence and improve the perioperative management of the surgical patient with diabetes requiring emergency surgery (and indeed any other co-morbidity).

Generic principles in the initial assessment and initial management of the emergency surgical patient with diabetes

The pathway for the emergency surgical patient with diabetes is at first appearance complicated. The principles are¹⁶:

- (i) Assess the need for immediate resuscitation.
- (ii) Perform resuscitation if required in parallel with further assessment.
- (iii) Assess the urgency of surgery.
- (iv) Assess co-morbidities.
- (v) Assess current glycaemic control with CBG and ketone levels.
- (vi) Assess need for the VRIII and prescribe correctly.
- (vii) Prescribe appropriate substrate fluids to run alongside VRIII (usually 5% glucose in 0.45% saline with premixed 0.15% potassium chloride).
- (viii) Prescribe appropriate resuscitative fluids.
- (ix) Ensure emergency treatment for hypoglycaemia and hyperglycaemia is prescribed.
- (x) Define frequency of CBG monitoring (hourly if on the VRIII).
- (xi) Define initial method of glycaemic control that is by either the VRIII; or manipulation of normal diabetes medication; or by fixed rate i.v. insulin infusion (FRIII) if the patient has DKA.
- (xii) Assess need for optimization, and then optimize, but not if this delays lifesaving surgery. Optimization in theatre suite should be considered if required.
- (xiii) Assess risk of perioperative AKI, and manage appropriately.

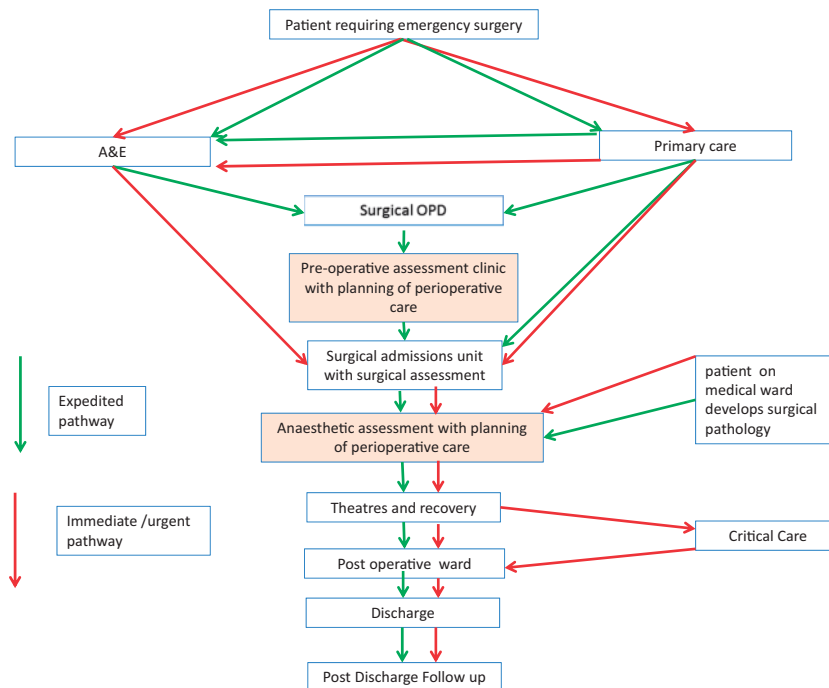


Fig 1 The pathway of the patient requiring emergency surgery.

- (xiv) Perform appropriate medicine reconciliation and withhold drugs as appropriate (e.g. NSAIDs; ACE inhibitors; metformin and sulphonylureas).
- (xv) Perform risk assessment and identify the high-risk patient to assess level of care required postoperatively.
- (xvi) Perform risk assessment for mortality and make the risk explicit to the patient and ensure that this is recorded clearly on the consent form and in the medical record.
- (xvii) Assess level of anaesthetic and surgical seniority required at surgery.
- (xviii) The decision to operate on high-risk patients should be made at consultant level, involving surgeons and those who will provide intra and postoperative care.
- (xix) Discuss and agree with the patient the postoperative analgesic strategy.
- (xx) Involve diabetologists and diabetic inpatient specialist nurses (DISNs) in the management of the patient in order to reduce excess length of hospital stay.¹⁷

Mandatory investigations generally include CBG; ketone levels; urea, creatinine, and electrolytes; full blood count and ECG. Arterial blood gases (ABG) and lactate may be indicated to allow scoring of severity of illness. Other investigations e.g. clotting studies; blood cultures; group and screen to be guided by clinical picture.

A CBG will guide whether the patient needs urgent glycaemic control, as it is recognized that poor preoperative glycaemic control is associated with a poorer outcome.

Capillary ketone levels >3 mmol litre⁻¹ will indicate that the patient has developed DKA. DKA in the surgical patient may be caused by surgical pathology, or may cause symptoms of the acute abdomen and therefore senior review is mandatory.

Only once a full and detailed assessment has been made can the patient be categorized as requiring expedited surgical care, urgent surgical care or immediate surgical care.

The patient should be prioritized to prevent needless excessive starvation, which would contribute to glycaemic variability, and ideally should be given a realistic time for surgery.

Management of the diabetes in patients requiring urgent and immediate surgical care

In the UK, the VRIII is the standard way of managing diabetes perioperatively. It should be used in the following circumstances:

- (i) Patient with Type 1 diabetes undergoing surgery with a starvation period greater than 1 missed meal.
- (ii) Patient with Type 1 diabetes undergoing surgery who has not received background insulin.
- (iii) Patient with Type 2 diabetes undergoing surgery with a starvation period greater than 1 missed meal and develops significant hyperglycaemia (CBG > 12 mmol litre⁻¹).
- (iv) Patients with poorly controlled diabetes as defined as a HbA1c $> 8.5\%$ (69 mmol mol⁻¹).

Many surgical patients with diabetes requiring emergency surgery will fall into one of these brackets and thus will require a VRIII.

As the VRIII is associated with many complications it is imperative that every hospital has comprehensive guidelines to facilitate its safe use. Box 1 highlights the salient points of safe use of the VRIII.

Management of diabetes in patients requiring expedited surgical care

Patients requiring expedited procedures can be managed in a similar manner as the elective surgical patient with diabetes provided certain criteria are met (Table 2). If the patient and the hospital are able to fulfil the criteria, then the patient can be

Box 1 The salient points in the safe use of the VRIII

As the use of the VRIII is associated with multiple incidents including:

- Hypoglycaemia.
- Hyperglycaemia.
- Ketosis because of either delayed establishment or delayed administration of sub cutaneous insulin on discontinuation.
- Hyponatraemia.
- Hypokalaemia.

It is, therefore, imperative that the following is performed:

- In patients with type 1DM, the establishment of the VRIII must never be delayed once the decision is made to manage the diabetes with i.v. insulin rather than s.c.
- The VRIII and the substrate solution must be administered through a dedicated cannula which includes appropriate anti-syphon one-way valves. No other drugs or fluids should be administered through this dedicated cannula.
- Hourly monitoring of CBG to maintain 'the range' of 6–10 mmol litre⁻¹.
- The substrate infusion is never inadvertently stopped, for example, during transfers.
- All hospitals must have guidelines for the safe use of the variable rate i.v. insulin infusion.
- It is now recognized that the use of the VRIII may often cause hypoglycaemia; furthermore this may be because the many scales previously promoted a target zone of 4–8 mmol litre⁻¹, and there was no safety buffer zone between safe and dangerous use. Therefore it is now advised that the scales be redesigned to promote all blood sugars to remain in the 6–10 mmol litre⁻¹ zone.
- As the half-life of soluble insulin is approximately 5 min, within 30 min of stopping a VRIII there will be no appreciable functioning insulin. If the patient has Type 1DM, DKA will ensue. Therefore, in Type 1DM patients the VRIII must never be taken down until alternative sub-cutaneous insulin has been administered.
- The Hospital Diabetic specialist nurse or diabetologist should be involved if there are concerns in transferring the patient off the VRIII.

Fluids to run alongside the VRIII

- The initial maintenance solution to be used alongside the VRIII is 5% dextrose in 0.45% saline with additional potassium chloride at a rate of about 1–1.25 ml kg⁻¹ h⁻¹ up to a maximum of 90 ml h⁻¹. The practice of alternating 5% glucose with 0.9% saline according to serum glucose is not recommended.
- To prevent hypoglycaemia, the substrate solution containing glucose must never be discontinued inadvertently, especially during transfers.
- Additional resuscitative fluids if required should be administered through a second cannula/central venous cannula and follow NICE CG 174 (i.v. fluid therapy in adults in hospital).
- Continuous administration of substrate fluid with glucose to permit continuous administration of insulin is mandatory in starved patients with T1DM, however this may not be the case in patients with T2DM. Some cardiac centres are running their i.v. insulin infusions to patients with T2DM with no additional glucose in the fluids. Likewise, patients that are established on TPN in critical care generally do not require additional substrate solution.

Treatment of CBG <4 mmol litre⁻¹ whilst on VRIII

- Reduce insulin rate accordingly.
- Administer 100 ml of 20% glucose.
- Recheck glucose every 15 min until CBG >6 mmol litre⁻¹, and then revert to hourly.

Management of CBG 4.1–6 mmol litre⁻¹

- Reduce insulin rate accordingly.
- Administer 50 ml of 20% glucose i.v. to prevent the CBG falling to below 4.0 mmol litre⁻¹.
- Fastidiously recheck glucose every hour to ensure CBG does not fall below 4 mmol litre⁻¹.

safely managed by manipulation of their usual diabetes medication. Recent published guidelines summarize the suggested changes to medication that can facilitate the avoidance of the VRIII in the surgical patient with diabetes.^{4,5} The patient is then able to have a safer hospital admission, safer surgery, safer recovery from surgery and resumption of normal diet, safer resumption of normal medication at normal doses and safer discharge without any of the complications associated with the use of the VRIII. However, it is still imperative that amongst other factors, glycaemic control is maintained.

These patients are typically stable and non-septic and can have a wide range of pathology e.g. tendon or nerve injuries; hand

injuries; soft tissue knee injuries; retinal detachment; evacuation of retained products of conception. As surgery is not urgent, there is time to gain all the appropriate clinical information and then manage accordingly. This process requires initial coordination by the surgeon. Appropriate clinical information includes:

- (i) long term glycaemic control as defined by glycosylated haemoglobin (HbA_{1c}) measured within last 3 months.
- (ii) normal medication with exact doses and times of administration and identification of the practitioner who normally looks after the patient's diabetes (i.e. primary or secondary care).
- (iii) patient's usual blood pressure.

Table 2 Criteria for the emergency surgical patient with diabetes to have their diabetes controlled by simple manipulation of normal medication

Patient/surgical factors	Institutional factors
<ul style="list-style-type: none"> • Normally adequate glycaemic control (as defined by HbA1c <69 mmol mol⁻¹ or < 8.5%) • Stable and non-septic • Not requiring immediate or urgent surgery • Ability to understand instructions • No expected surgical reason for post-operative starvation/ileus 	<ul style="list-style-type: none"> • Ability to reliably give the patient a time for surgery to ensure that the patient will only miss one meal • Ability to prioritize the patient on the operating list • Ability for a trained member of staff to discuss perioperative manipulation of drugs with the patient, ensuring that the patient is able to follow the instructions • Ability to perform safe discharge of the surgical patient with diabetes and ensure that the patient understands when to seek medical advice (i.e. follow 'sick day rules')

Box 2 The salient points of DKA management

- (i) DKA is a life-threatening medical emergency characterized by the biochemical triad of ketonaemia, hyperglycaemia, and acidaemia
- (ii) Bedside monitoring of capillary ketones, glucose, blood gases, and electrolytes should be used to make the initial diagnosis and guide subsequent management
- (iii) Weight based FRIII is now recommended rather than a VRIII
- (iv) Measurement of CBG must be performed at least hourly whilst the patient is on the FRIII
- (v) It is recognized that the use of the FRIII is associated with hypoglycaemia, and additional i.v. glucose must be administered once the CBG is <14 mmol litre⁻¹
- (vi) 0.9% Saline with premixed potassium chloride should be the main resuscitation fluid on the general wards and in theatre since this complies with National Patient Safety Agency recommendations on administration of potassium chloride
- (vii) Balanced electrolyte solutions are associated with a faster resolution of acidosis, but contain insufficient potassium to justify their safe use except in critical care
- (viii) The cause of the DKA must be sought and surgery may be required.
- (ix) Critical care may be required
- (x) Continuation of long acting insulins may reduce complications during transition from i.v. to subcutaneous insulin
- (xi) Early involvement of diabetic specialist teams is mandatory

(iv) co-existing morbidity.

Patients are then seen either by an anaesthetist or by a preoperative assessment nurse and assessed for suitability for management of their diabetes by manipulation of their usual medication (see Fig. 1). They can then be either admitted to the ward, with a date and time of surgery, or be bought back for an elective list, with a definitive time and date for surgery, thus obviating all the dangers associated with the VRIII.

Furthermore, medical in-patients who subsequently require expedited surgery can be considered for this management pathway (see Fig. 1).

Management of the emergency surgical patient with a continuous subcutaneous insulin infusion/pump therapy

If the patient has no metabolic and physiological disturbance, it is possible to allow the patient to maintain control of their diabetes with the continuous subcutaneous insulin infusion (CSII). Generally this only applies to patients requiring expedited emergency surgery. The patient should set the pump to maintain a CBG of 6.0–10.0 mmol litre⁻¹. This may involve reducing the basal rate by 20%. Whilst anaesthetized, the anaesthetist

must measure the CBG hourly meticulously, and be prepared to treat dysglycaemia. Otherwise the VRIII must be used.¹⁸

Management of the surgical patient with DKA

Occasionally the patient with diabetes may present with DKA secondary to a surgical catastrophe and will require immediate surgery e.g. debridement of tissues secondary to necrotising fasciitis. In these circumstances the patient will need to have their DKA treated in theatre. Current opinion is that DKA is best managed with a FRIII, as it promotes faster resolution of the DKA, and the insulin infusion is maintained until the ketosis has resolved. Furthermore, it avoids titrating the insulin against the erroneous surrogate marker of blood glucose.

Management of DKA with the FRIII has recently been reviewed.¹⁹ The salient points of current management of DKA are summarized in Box 2. It is also salutary to note that DKA may mimic the surgical abdomen, and prior to performing emergency surgery in patients with diabetes, DKA must be excluded as the cause of the acute abdomen.

Postoperatively the patient should be managed in a critical care environment, and the FRIII should only be discontinued once the ketotic state has been successfully treated. Once the ketosis is resolved the FRIII can either be converted to the VRIII

or the patient can resume their usual medication once they are eating and drinking normally.

Intraoperative/anaesthetic management of the emergency surgical patient with diabetes

The emergency surgical patient with diabetes may often require various infusions which may necessitate central venous access. Furthermore, as these patients are at risk of AKI and also require regular monitoring of CBG and electrolytes, invasive blood pressure monitoring is advised. Use of goal directed fluid therapy with cardiac output monitoring is also advocated if available.

Anaesthetic technique should be geared towards promoting cardiovascular stability. Additionally, a technique that promotes early postoperative drinking and eating is advocated, as this allows the patient to resume their usual medication, and avoids reliance on the VRIII.

Multimodal opioid sparing analgesia is preferable as it reduces the incidence of postoperative nausea and vomiting. The use of regional anaesthesia has benefits in reducing postoperative opioid consumption, however regional anaesthesia is associated with extra morbidity in the patient with diabetes (increased risk of infections including epidural abscesses and increase risk of nerve injury).⁵

CBG must be maintained between 6 and 10 mmol litre⁻¹ to prevent harm from dysglycaemia.

Postoperative management of the emergency surgical patient with diabetes

Postoperatively, the patient should be cared and managed in a level of care appropriate to their needs. Strategies to enable prompt resumption of eating and drinking and limiting postoperative nausea and vomiting are to be encouraged, as this will facilitate early resumption of normal medication.

If the VRIII is used, it should only be taken down once the patient is eating and drinking and resumed their usual medication.

Good quality medical and nursing care should be provided to reduce the risk of the predictable complications e.g. AKI, pressure ulcers, hypo- and hyperglycaemia, wound infections, DKA, and drug related harm.

Discharge

It is imperative that the patient is informed on how to manage their diabetes on discharge, to be vigilant for surgical complications, and to be told how to seek medical help if required. Most patients will be familiar with this type of advice through 'sick day rules'.⁴

Special points in managing the emergency surgical patient with diabetes

Role of diabetologist/diabetic inpatient specialist nurse

The Diabetes National Service Framework (NSF) stresses the importance of a good diabetes service for all in-patients with diabetes and the need to assess patient satisfaction with the service they receive. It concludes that in-patient diabetes services could be improved by a Diabetes Inpatient Specialist Nurse (DISN) service, supported by diabetologists. A DISN service has been shown to reduce the length of stay for patients with diabetes, whatever the reason for admission.¹⁷

Management of the surgical patient with diabetes at risk of perioperative AKI

Accepted risk factors for developing AKI include¹³:

- (i) emergency surgery, especially when the patient has sepsis or hypovolaemia
- (ii) intraperitoneal surgery
- (iii) chronic kidney disease (adults with an eGFR < 60 ml min⁻¹/1.73 m² are at particular risk)
- (iv) diabetes
- (v) heart failure
- (vi) age 65 yr or over
- (vii) liver disease
- (viii) use of drugs with nephrotoxic potential in the perioperative period (in particular, NSAIDs after surgery).

Thus a 70 yr old patient with diabetes requiring an emergency laparotomy will have at least four risk factors for developing AKI.

The perioperative management of the patient at risk of AKI can be summarized by²⁰:

- (i) Daily measurement of urea, creatinine, and electrolytes
- (ii) Aiming for euvolaemia and giving appropriate fluid challenges whilst avoiding iatrogenic fluid overload
- (iii) Maintaining an adequate urine output (which is not necessarily >0.5 ml kg⁻¹)²¹
- (iv) Stopping and avoiding nephrotoxic agents
- (v) Maintaining an effective blood pressure
- (vi) Considering and excluding obstruction to the renal tract
- (vii) Appropriate escalation to renal/critical care specialists as required.

Summary

It is recognized that a number of factors apart from dysglycaemia contribute to the excess morbidity and mortality and length of stay of the patient with diabetes requiring emergency surgery. Many of these factors are modifiable, and by adopting the concept of aggregation of marginal gains, a concept adopted by the enhanced recovery programmes, the care and outcome for these patients can be improved. Some of these modifiable factors will need institutional or organizational change (e.g. managing expedited emergency patients on elective trauma lists after comprehensive planning), but many simply require good medical practice by the attending perioperative team.

Declaration of interest

The authors declare that there is no conflict of interest associated with this manuscript.

MCQs

The associated MCQs (to support CME/CPD activity) can be accessed at <https://access.oxfordjournals.org> by subscribers to *BJA Education*.

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