Diabetes and surgery

Diabetes is a major healthcare challenge for both primary and secondary care, affecting approximately one in 10 people over 65 years of age. An esimated 25% of people with diabetes undergo surgical procedures, often as a result of complications. Mortality rates have been estimated to be up to five times greater in patients with diabetes than those without the condition, and adverse surgical outcomes have been documented aft er a range of procedures.

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Diabetes is a major healthcare challenge, said to affect approximately one in 10 people over 65 years of age. The UK prevalence in men aged 65–74 years age increased from 5.8% in 1994 to 15.7% in 2006, while that in women increased from 4.8% to 10.4%.[1] All primary and secondary care specialists will therefore encounter patients with this condition in their day-to-day practice.

People with diabetes undergo surgical procedures, sometimes as a result of complications, at a higher rate than patients without the condition; an estimated 25% require surgery at some point in their lives.[2] Studies have demonstrated adverse surgical outcomes following a range of procedures including transmetatarsal amputation,[3] spinal[4] and cardiac surgery.[2,5,6] Elderly patients are less likely to tolerate resulting metabolic and infective complications.

Preoperative considerations

Improved glycaemic control in both the short and long term has been shown to reduce perioperative morbidity and mortality,[5] and performing elective surgery in this population potentially allows time for such optimisation. Factors contributing to adverse perioperative outcomes and perioperative treatment decisions are listed in box 1 and 2, respectively. Glycaemic targets should be tailored to the individual patient. For example, stringent glycaemic control resulting in hypoglycaemia may lead to more risk than benefit in an elderly patient with cognitive impairment due to their impaired ability to recognise, treat and

Box 1: Factors contributing to adverse perioperative outcomes[5]

- Surgical induction of the stress response
- Interruption of food intake
- Altered consciousness, masking hypoglycaemia
- Circulatory disturbances associated with anaesthesia and surgery aff ecting the absorption of subcutaneous insulin

Box 2: Factors affecting perioperative treatment decisions

- Type of surgery planned:
- Timing and duration of surgery
- Type of anaesthetic planned
- Possibility of escalation from minor to major surgery
- Risk of renal hypoperfusion and tissue hypoxia
- Normal treatment for diabetes
- Recent glycaemic control
- Patient comorbidity, especially renal failure and congestive cardiac failure

recover from such episodes. Elderly patients may also require flexible goals to account for co-morbidities, mental status and social situation.

In the 5% of patients with diabetes who require emergency surgery, preoperative focus shifts towards correction of significant derangements of volume and electrolytes as well as the exclusion of diabetic ketoacidosis (DKA), which may masquerade as a surgical emergency.[7] Certain groups of patients with type-2 diabetes are, as a result of severe beta-cell dysfunction, also prone to episodes of DKA. Inpatient management in this scenario should not vary from standard practice.

"As diabetes increases in prevalence and newer agents prolong survival, more older patients will likely be referred for surgery"

Preoperative assessment in both elective and emergency cases should aim to identify known complications, including nephropathy and ischaemic heart disease. These are of particular relevance given the common use of intravenous fluids in the fasting patient. Further complications of diabetes should also be identified early in the process; hypertension and autonomic neuropathy may lead to haemodynamic instability during anaesthesia, whilst delayed gastric emptying may increase the tendency to aspiration. The sight of patients with advanced retinopathy may be vulnerable to acute blood pressure changes during anaesthesia whilst the increased frequency of respiratory and wound infections in patients with diabetes requires increased vigilance.

Management

Management strategies for patients with diabetes during and after surgical procedures are described in table 1 on page 263. Inpatient treatment should be based on a patient's usual management. Other considerations may include the nature and extent of proposed surgery as well as preceding glycaemic control. The general principles include regular capillary blood glucose monitoring, appropriate hydration and, where possible, early placement on the theatre list. This is important to reduce time spent fasting, thus minimising disruption to normal treatment as well as hyperglycaemic and hypoglycaemic excursions. Patients well controlled with diet alone should not require specific treatment except avoidance of intravenous dextrose. Patients treated with metformin should have this agent withheld for 48 hours preoperatively in view of the potential risk of tissue hypoxia and lactic acidosis during surgery. In the case of emergency surgery, it is important to ensure metformin is withheld for 48 hours after surgery and then reintroduced when renal function is normal. Other oral agents may be withheld on the day of surgery to prevent hypoglycaemic events related to disrupted eating patterns. No specific adjustments are required for patients undergoing local anaesthetic.Insulin-treated patients with poorly controlled diabetes may be placed on an intravenous regimen of insulin infusion. Close monitoring and appropriate adjustment by well trained staff is mandatory for success. Insulin and glucose solutions can be infused separately, or combined together in a glucose insulin potassium (GIK) solution. This regimen is considered efficient, effective and safe.[7] Disadvantages of the GIK solution include a requirement to change the whole solution in order to adjust insulin delivery as well as a potential for ketosis in patients with type-1 diabetes if the solution is stopped.[8]

Conclusion

In summary, as diabetes increases in prevalence and modern agents enable prolonged survival in older patients with advanced complications, an increasing number of patients will probably be referred for surgery. Perioperative care is of particular importance as failure to manage diabetes appropriately could lead to metabolic decompensation or suboptimal surgical outcomes—at best, delayed discharge; at worst, increased complication rates or death. An individualised approach to management based on careful assessment, preoperative optimisation, and vigilance in the postoperative period optimises a patient's chances for a good outcome.

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Table 1: Management strategies during and after surgery in patients with diabetes

Type of diabetes management	Minor surgery. Patient expected to eat within 4 hours of surgery. Check capillary blood glucose (CBG) 1hr pre-op.	Major surgery. Patient expected not to eat within 4 hrs of surgery. Check CBG 1hr preop; hrly intraop until 4 hours postop; 2 hrly until stabilisation, then 4 hrly.[9]
Type 2: Diet controlled	Check CBG pre-op. No other adjustments needed if patient well controlled on dietary therapy. Avoid intravenous dextrose.	Consider insulin infusion if patient poorly controlled on diet therapy.
Type 2: Metformin treated	Omit tablet on morning of surgery. If risk of proceeding to major surgery, omit tablet for 48hrs.	Omit metformin for 48hrs, especially in sick patients with renal impairment. Restart once eating, drinking and renal function are normal. If CBG poorly controlled, establish insulin infusion.
Type 2: Other oral agents	Omit all oral hypoglycaemics on day of surgery. Check CBG 1hr pre-op and 4 hrly post-op until eating. If pre-op CBG>10mmol/L, commence insulin infusion.[9] Restart tablets with first meal.	Omit all oral hypoglycaemics on day of surgery. If CBG poorly controlled, establish insulin infusion. Exceptions: Consider stopping/substituting thiazolidinediones earlier in vulnerable groups in whom fluid retention may precipitate congestive cardiac failure.[8] Stop long-acting chlorpropamide 3 days prior to surgery.[7] Restart sulphonylureas once patient is eating and titrate to higher doses.
Insulin treated patients	Generally patients can continue with sc insulin if procedure is not long or complex. For minor, early morning procedures, patients may delay morning insulin until after surgery and before eating.[8]	
Type 2: Long-acting insulin	Continue sc insulin until day before surgery. Omit sc insulin on morning of procedure if CBG<7. Commence long-acting insulin later in day/morning after surgery at normal time if patient is eating. Consider conversion to intermediate-acting insulin several days prior to surgery if control is not optimised/frequent hypos are noted.	Continue sc insulin until day before surgery. Omit on day of surgery and start insulin infusion. If poorly controlled pre-op, aim to admit patient 1–2 days early to commence insulin infusion and optimise control.
Type 2: Twice daily insulin	Give usual sc insulin on day prior to surgery. Omit morning insulin on day of surgery if CBG<7; give half usual levels if CBG>7. Monitor intraoperative CBG at least once; every 2 hrs until eating, then every 4 hr. Restart normal sc insulin with first meal.[9]	Normal medication on day before surgery. Reduce nocté dose if "tight" control noted. Omit sc insulin on day of surgery and start insulin infusion. Check blood glucose 1 hr preop; check each hr until 4 hrs postop; every 2 hrs until stable, then every 4 hrs.[9] If CBG poorly controlled pre-op, aim to admit patient 1–2 days early to commence insulin infusion and optimise control.
Type 2: Basal bolus insulin	Take normal sc insulin on day prior to surgery. Omit morning insulin on day of surgery if CBG<7. Administer half normal insulin if CBG>7. Monitor intraoperative CBG at least once; each 2 hrs until eating, then each 4 hrs. Recommence normal sc insulin with first meal.[9]	Omit short-acting insulin on morning of surgery and start insulin infusion. Check blood glucose 1 hr preop; then each hr until 4 hrs postop; each 2 hrs until stabilised, every 4 hrs once stable.[9] If poorly controlled pre-op, aim to admit patient 1–2 days early to commence insulin infusion and optimise control.
Type 2: GLP-1 analogue/DPP-IV inhibitor therapy	Dipeptidyl peptidase-4 inhibitors (DPP-IV) and glucagon-like peptide (GLP-1) analogs may alter gastroinestinal motility and worsen postoperative state. Omit on day of surgery.[8] Recommence when eating.	Continue normal medication until day before surgery. Omit on day of surgery and start insulin infusion. If poorly controlled pre-op, aim to admit patient 1–2 days early to commence insulin infusion and optimise control.
Type 1: Basal bolus/twice daily insulin	Take normal meds on day prior to surgery. Omit morning sc insulin if CBG< 7. Give half normal insulin if CBG>7. Monitor CBG 1 hr preop, intraoperatively at least once, 2 hrly until eating and then 4 hrly. Recommence normal sc insulin with first meal.[9] Of particular importance, patients should continue with basal insulin the night before, even in the absence of oral intake, in order to prevent ketoacidosis.[8]	Continue normal medication until day before surgery, omit on day of surgery and start insulin infusion. If poorly controlled pre-op, aim to admit patient 1–2 days early to commence insulin infusion and optimise control.

Box 3: Potential postoperative complications in patients with diabetes

- Skin ulceration of vulnerable areas during periods of immobility
- Myocardial ischaemia which may be precipitated by surgery and present atypically
- Renal impairment due to urinary retention, infection and nephrotoxic anaesthetic and analgesic agents
- Hypoglycaemia—due to factors such as fasting, nausea and sepsis
- Hyperglycaemia—due to factors such as sepsis and total parenteral nutrition
- Hyperosmolar nonketotic coma

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