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Emergent Perioperative Hyperglycemia Management

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Abstract:	Persons with diabetes require surgical procedures at a higher rate and have longer hospital stays than those without diabetes. 1. In particular, diabetes patients admitted for general and orthopedic surgery have some of the longest overall lengths of hospital stay 2. The presence of diabetes and/or hyperglycemia in surgical patients also leads to increased morbidity and mortality, with perioperative mortality rates up to 50% higher than the non-diabetes population 3. The reasons for these adverse outcomes are multi-factorial, but includes failure to identify patients with diabetes and/or hyperglycemia4; 5multiple co-morbidities including microvascular and macrovascular complications 6-12 complex polypharmacy and insulin prescribing errors 13; increased perioperative and postoperative infections 3;14;15; associated hypoglycemia and hyperglycaemia 3; lack or inadequate institutional guidelines for management of inpatient diabetes and/or hyperglycemia 3;16; and inadequate knowledge of diabetes and hyperglycemia management amongst staff delivering care.

Emergent Perioperative Hyperglycemia Management

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Introduction

Persons with diabetes require surgical procedures at a higher rate and have longer hospital stays than those without diabetes [1]. In particular, diabetes patients admitted for general and orthopedic surgery have some of the longest overall lengths of hospital stay [2]. The presence of diabetes and/or hyperglycemia in surgical patients also leads to increased morbidity and mortality, with perioperative mortality rates up to 50% higher than the non-diabetes population [3]. The reasons for these adverse outcomes are multi-factorial, but includes failure to identify patients with diabetes and/or hyperglycemia[4;5]; multiple co-morbidities including microvascular and macrovascular complications [6-12] complex polypharmacy and insulin prescribing errors [13]; increased perioperative and postoperative infections [3;14;15]; associated hypoglycemia and hyperglycaemia [3]; lack or inadequate institutional guidelines for management of inpatient diabetes and/or hyperglycemia [3;16]; and inadequate knowledge of diabetes and hyperglycemia management amongst staff delivering care.

Several studies have shown that high preoperative and perioperative glucose and glycosylated haemoglobin (HbA1c) levels lead to poor surgical outcomes. These findings occur in both elective or emergency surgery, and include various types of surgery including spinal [17], vascular [18], colorectal [19], cardiac [20;21], trauma-related [22], mastectomy [23], foot and ankle [24], neurosurgery, and hepatobiliary surgery [25;26]. Adverse outcomes related to increased morbidity and mortality includes increased wound infection rates, urinary tract infections, admission and time in intensive care, development of acute kidney

injury (AKI), or acute coronary syndromes (ACS). However, there are data to show that the outcomes of persons with diabetes may not be different – or may indeed be better – than those without diabetes if the diagnosis is known prior to surgery [27;28]. The reasons for this are unknown, and may be due to increased vigilance surrounding glucose control given to those with a diagnosis of diabetes.

In view of these findings, elective surgery with acceptable glycemic control (e.g. HbA1c <8.5% and ambient glycemic levels within acceptable range) and no evidence of diabetes-related acute decompensation (e.g. diabetic ketoacidosis [DKA], hyperglycemic hyperosmolar state [HHS], or electrolyte disturbance) would be the preferred option for diabetes patients requiring surgery (Figure 1). However, approximately 5% of persons with diabetes will require emergency surgery over their lifetime [29]. Emergency surgery is performed on patients who have an acute condition that threatens life, limb or the integrity of a body structure. Some emergency operations are time critical and need to be performed immediately (day or night). Emergency surgical care comprises 40–50% of the workload of most surgical specialties, and can result in additional complications, higher mortality (25%), increased costs, and is disruptive to elective surgery planning and implementation. By definition, the time of occurrence of these emergencies cannot be predicted, and appropriate surgical care must not be unduly delayed. Nonetheless, particular care must be taken in persons with diabetes who are being considered for emergency surgery to exclude DKA and other conditions (e.g. vomiting related to undiagnosed or poorly controlled gastroparesis or glucagon-like

peptide-1 [GLP-1] agonist adverse effect) that may be mistaken for surgical emergencies. Many patients with DKA and prominent abdominal symptoms have undergone needless surgical exploration for a nonexistent acute abdominal emergency.

Approaches to Management

The actual treatment recommendations for a given patient should be individualized based on factors such as current glycemic control, type of diabetes, nature and extent of surgical procedure, and antecedent diabetes therapy [30]. Unfortunately, many patients who require emergency surgery will have suboptimal glycemic control. However, this is not necessarily a contraindication to the timely performance of potentially life-saving surgery. An intravenous (IV) access should be secured and immediate blood specimens should be sent for glucose, electrolyte, and acid-base assessment. Gross derangements of volume and electrolytes (e.g. hypokalemia, hypernatremia) should be corrected. Surgery should be delayed, whenever feasible, in patients with DKA, so that the underlying acid-base disorder can be corrected or, at least, ameliorated. Patients with HHS are markedly dehydrated and should be restored to good volume and improved metabolic status before surgery. For those having emergency surgery, aiming for a pragmatic blood glucose of between 110-180 mg/dl (6-10 mmol/L) should be the target. Blood glucose should be monitored at least hourly during the procedure and in the immediate postoperative period using an appropriate point-of-care measure to allow early detection of any alterations in metabolic

control. All patients receiving insulin before admission require insulin during the perioperative period. In the emergency setting, this is best achieved using continuous intravenous insulin infusion (CII, also known as variable rate intravenous insulin infusion [VRIII]). Other patients not previously on insulin therapy should be reviewed on an individualized basis to determine appropriate therapy. Patients not expected to miss more than one meal (i.e. short starvation period) might be candidates for alternative glucose-lowering therapies without the need for CII (VRIII). In comparison, patients expected to miss more than one meal should generally have a CII (VRIII). However, if blood glucose concentration rises above 180 mg/dl (10 mmol/L), a CII (VRIII) should be commenced and continued until the patient is eating and drinking. CII (VRIII) are often poorly managed in the perioperative setting and thus require explicit guidelines including how to transition from IV to subcutaneous insulin or noninsulin therapies. Other important factors includes optimizing and maintaining volume status, electrolyte balance, avoidance of pressure damage to the feet during surgery, and prevention and optimal treatment of hypoglycaemia. Early involvement of the critical care and diabetes specialist teams is recommended in the management of any high-risk surgical patient with diabetes and/or hyperglycemia.

Summary

There is a wealth of evidence to show that poor preoperative, perioperative and postoperative glycemic control is associated with poor surgical outcomes. Despite the lack of robust data to confirm this, most clinicians agree that controlling glucose levels to an acceptable range is likely to reduce the risk of developing complications. The management goal is to optimize metabolic

control through close monitoring, adequate fluid and caloric repletion, and judicious use of insulin.The management of perioperative glucose control in the emergency setting usually requires the use of a CII (VRIII). However, where opportunities arise to optimise glycemic control preoperatively (especially to allow stabilization of patients with diabetes-related crises), then these should be undertaken.

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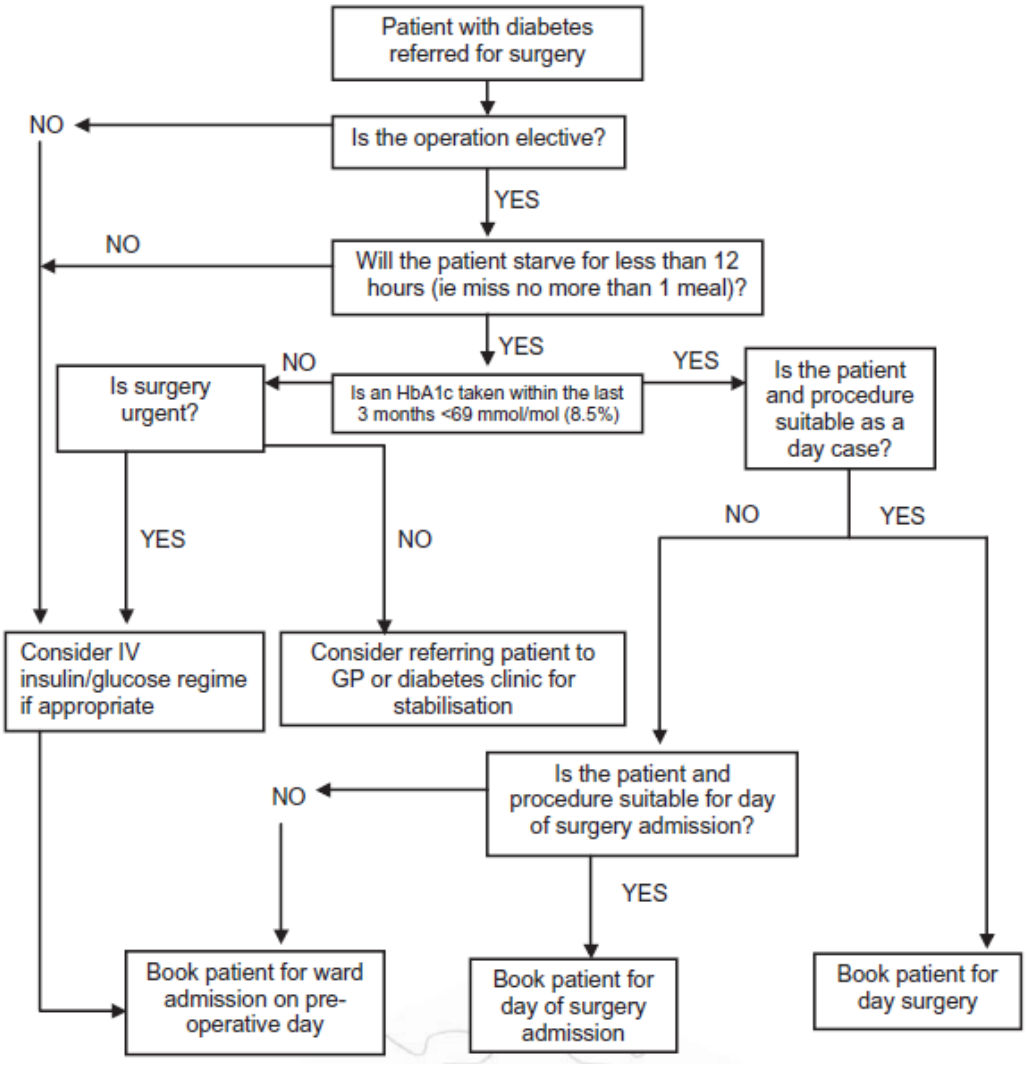
Legend to Figure 1.

An example of an algorithm to see if a patient with diabetes is suitable for day case surgery or not

Figure 1


Patient with diabetes referred for surgery
Is the operation elective?
NO
YES
Will the patient starve for less than 12 hours (ie miss no more than 1 meal)?
NO
YES
Is an HbA1c taken within the last 3 months <69 mmol/mol (8.5%)
NO
YES
Is surgery urgent?
Is the patient and procedure suitable as a day case?
YES
NO
NO
YES
Consider IV insulin/glucose regime if appropriate
Consider referring patient to GP or diabetes clinic for stabilisation
Is the patient and procedure suitable for day of surgery admission?
NO
YES
Book patient for ward admission on pre-operative day
Book patient for day of surgery admission
Book patient for day surgery