The patient with endocrine disease

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Abstract

Uncontrolled endocrine pathology can cause significant adverse complications during a patient's perioperative journey. With the ageing population, increasing comorbidity and rising obesity rates, the incidence of endocrine disease in elective and emergency work is likely to increase. A thorough understanding of diagnosis and management perioperatively is essential to prevent any excess morbidity and mortality. The perioperative period may precipitate endocrine emergencies which require rapid diagnosis and life-saving treatments. This article will cover the management of diabetes, thyroid and adrenal disease in the perioperative period.

Keywords Addison's disease; adrenal; diabetes mellitus; diabetic ketoacidosis; endocrine system; hormones; perioperative medicine; phaeochromocytoma; thyroid disease; thyroid storm

Introduction

The endocrine system plays a crucial role in the control of electrolytes, cardiac output and metabolism by secretion of hormones from endocrine glands to act on distant sites. Complex feedback mechanisms and interactions occur to enable the body to respond to stressors. Endocrine disease can occur due to pathology of endocrine glands, dysregulation of feedback mechanisms, or due to secretion of hormones from ectopic sites. Surgical patients may have chronic disease or receive a diagnosis of endocrine disease during the perioperative work up. These diagnoses may or may not be linked to the primary surgical pathology. Paraneoplastic syndromes and neuroendocrine tumours can cause disease via secretion of physiologically active substances. It is essential that physicians caring for patients in the perioperative period understand the potential complications arising in endocrine disease. Acute endocrine emergencies carry a significant morbidity and mortality.

Diabetes mellitus

Diabetes mellitus is a condition of hyperglycaemia due to insulin insufficiency, peripheral resistance to insulin or a combination of both.[1] Diagnosis is made when a patient has a fasting plasma glucose ≥7.0 mmol/L or 2-hour post carbohydrate load plasma glucose ≥11.1 mmol/L or Hba1c ≥ 48 mmol/mol.[2]

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Diabetes affects 10–15% of the surgical population. These patients require more surgical procedures than non-diabetic patients and their perioperative morbidity and mortality is up to 50% higher.[3] The significant rise in obesity may result up to 50% of the population suffering with diabetes in the next decade. One in three diabetic patients had a medication error during their hospital stay in 2017, 4% developed diabetic ketoacidosis and one in five had hypoglycaemic episodes.[4] Poor glycaemic control is associated with increased incidence of complications including postoperative surgical site infection and increased length of hospital stay.[3]

Type 1 diabetes is caused by a lack of endogenous insulin due to autoimmune destruction of pancreatic beta cells in the islets of Langerhans. Treatment is with lifelong insulin either as bolus injections or via an insulin pump.

Type 2 diabetes is caused by a relative lack of insulin and/or a decrease in peripheral insulin sensitivity. It is associated with obesity and a sedentary lifestyle, so first line treatment involves lifestyle modification and dietary advice. However, patients may go on to require antidiabetic medication (Table 1) or insulin treatment.

Perioperative management

Diabetic patients will often be subject to polypharmacy and multiple comorbidities making perioperative optimization and management more complex. Many of the factors that lead to increased morbidity and mortality are modifiable. In elective cases the increased risk of complications may warrant operation delays to enable optimization. In the emergency setting this may not be possible, and indeed the acute illness may be precipitating poor control. Careful management of blood sugar is essential to avoid preventable complications and life threatening diabetic emergencies.

Diabetes causes macrovascular and microvascular complications. Ischaemic heart disease (including 'silent' myocardial infarction), hypertension, stroke and peripheral vascular disease are macrovascular complications. Microvascular complications include retinopathy, nephropathy and neuropathy, both somatic and autonomic. Preoperatively patients require a thorough work up with investigation and optimization of comorbidities. As a minimum they require HbA1c (glycated haemoglobin), urea and electrolytes and an ECG.[2] The preoperative period provides an important opportunity to educate patients about lifestyle modifications. The psychological overlay of the planned operation may provide new motivation.

HbA1c represents average blood sugars over the previous 8–12 weeks, which is the life span of a red blood cell. Levels help diagnose diabetes and monitor control. In health HbA1c should be below 42 mmol/mol. Pre-diabetes is suggested with an Hba1c between 42 and 48 mmol/mol and diabetes can be diagnosed with an Hba1c over 48 mmol/mol. HbA1c over 69 mmol/mol suggests poorly controlled diabetes.

There are limitations to this test and care should be taken in interpreting results. The reduced life of a red blood cell in patients with haemoglobinopathies can make this test inaccurate. In those patients with frequent hypo-glycaemic episodes their HbA1c may be low, but this does not necessarily represent good

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Non-insulin diabetes medications

Class *Examples*	Mechanism	Risks	For a.m. surgery	For p.m. surgery	If on VRIII
Intestinal alpha glucosidase inhibitors *Acarbose*	Reduced intestinal glucose absorption		Omit am dose if NBM	Give a.m. dose if eating	Stop while on VRIII, recommence when eating and drinking normally
Meglitinide *Repaglinide, nateglinide*	Increase insulin secretion	hypoglycaemia	Omit am dose if NBM	Give a.m. dose if eating	
Biguanide *Metformin*	Increase sensitivity to insulin	Acute kidney injury and lactic acidosis	Take am dose if low risk of AKI.Omit lunchtime dose if taking TDS	Take a.m. dose if low risk of AKI. Omit lunchtime dose if taking TDS	
Sulphonylurea *Glibenclamide, gliclazide, glipizide, glimepiride*	Increase insulin secretion	hypoglycaemia	Omit am dose	Omit a.m. dose and pm dose if taken BD	
Thiazolindinediones *Pioglitazone*	Increase sensitivity to insulin		Take as usual	Take as usual	
DPP 4 inhibitor *Sitagliptin, vidagliptin, saxagliptin, alogliptin, linagliptin*	Stimulate insulin release in response to food	Contra indicated in renal failure	Take as normal	Take as normal	
GLP-1 analogue (taken subcut) *Exenatide, liraglutide, lixisenatide, duladlutide*	Stimulate insulin release in response to food	Contra indicated in renal failure	Take as normal	Take as normal	Take as normal
SLG-T inhibitors *Dapaglifozin, canagliflozin, empagliflozin*	Reduce renal glucose reabsorbtion	euglycaemic ketoacidosis	Omit on day of surgery	Omit on day of surgery	Omit until eating and drinking normally

Table 1

control. This average value over up to 12 weeks may be hiding large and unsafe swings in blood sugar that need to be controlled prior to surgery.

Ideally, HbA1c should be less than 69 mmol/mol prior to elective surgery. Patients with difficult control should be assessed on a case by case basis. It may not be safe to aim for a lower HbA1c in patients who are at high risk of hypoglycaemic episodes, especially in patients with asymptomatic hypoglycaemia. Referral to a diabetic specialist should be considered in treated patients with Hba1c >69 mmol/mol and those with asymptomatic hypoglycaemia regardless of HbA1c.

Perioperative hyperglycaemia and hypoglycaemia must be avoided. In well controlled diabetic patients presenting for elective surgery this is best achieved with minimal disruption to their normal diabetic control. However, a variable rate intravenous insulin infusion (VRIII) may be required in the following situations:

- type 1 patients missing more than one meal
- type 1 patients who have missed their long acting insulin
- type 2 patients missing more than one meal if glucose >12 mmol/l
- HbA1c >69 mmol/mol
- most patients requiring emergency surgery.[2]

Capillary blood glucose (CBG) should be measured hourly perioperatively. The target CBG for patients taking glucose lowering medications is 6–10 mmol/l. A CBG between 3.5 and 10 mmol/l is considered safe in awake patients who are not taking glucose lowering medications.[2]

Antidiabetic drugs can be broadly categorized into those that reduce blood glucose levels (insulin, sulphonylureas, meglitinides) and those that prevent blood glucose levels from rising (biguanides, pioglitazone, acarbose, DDP inhibitors, GLP analogues, SGLT-2 inhibitors). The former must be reduced during times of fasting to prevent hypoglycaemia, the latter will only need to be altered if there is concern about drug specific complications. Examples include lactic acidosis with metformin or euglycemic ketoacidosis with SGLT-2 inhibitors.[5] Recommended alterations to diabetic medications perioperatively are summarized in Table 1.[2]

There is a large variety of insulin preparations and insulin delivery devices. Caution must be taken when prescribing to ensure the patient receives the correct insulin. Administration of inadvertent insulin overdose due to abbreviations or use of incorrect devices is classified as a never event. Insulin preparations can be short acting, intermediate acting, long acting, or a pre-mixed preparation. Dependent on the preparation and timing

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Perioperative management of insulin

Insulin regime	Day before surgery	Patient for a.m. surgery	Patient for p.m. surgery	If VRIII used
Once daily long/ intermediate acting in evening	Reduce dose by 20%			Continue at 80% of usual dose
Once daily long/ intermediate acting in morning	Reduce dose by 20%	Reduce dose by 20%	Reduce dose by 20%	Continue at 80% of usual dose
Twice daily injection of pre mixed insulin	No change	Half morning dose Usual evening dose	Half morning dose Usual evening dose	Stop until eating and drinking normally
Twice daily injections of separate short and intermediate acting	No change	Calculate total usual dose of short and intermediate. Give half usual units as all intermediate Usual evening dose	Calculate total usual dose of short and intermediate. Give half usual units as all intermediate Usual evening dose	Stop until eating and drinking normally
3 times a day injection mixed insulin	No change	Half morning dose Omit lunchtime dose Usual evening dose	Usual morning dose Omit lunchtime dose Usual evening dose	Stop until eating and drinking normally
Basal bolus regime: 3 short acting injections with meals in addition to long acting insulin	No change	Omit morning and lunch time short acting doses Reduce morning long acting by 20%	Normal morning dose Omit lunchtime dose	Stop short acting until eating and drinking. Continue long acting at 80%

Table 2

of administration, it may be necessary to reduce insulin doses during fasting to prevent hypoglycaemia. Insulin dependent diabetics must never have insulin completely omitted as they are at risk of developing diabetic ketoacidosis (DKA). Perioperative alterations to common insulin regimes can be found in Table 2.

Insulin pumps deliver a continuous supply of subcutaneous short acting insulin. Boluses are delivered via the pump and controlled by the patient. Patients with this regime generally have a good understanding of their diabetes. During the perioperative period, if one meal will be missed the pump can be continued at the background rate, but if more than one meal will be missed the pump should be removed and a VRIII started.[2]

With the exception of those with diet-controlled type 2 diabetes, diabetic patients should be first on the list to ensure minimal disruption to diabetic control. This will be an increasingly difficult task with the ever-increasing number of diabetic patients. Evening operating lists are not appropriate for these patients. Postoperative nausea and vomiting should be avoided and treated aggressively to enable resumption of usual diet as soon as possible. Enhanced recovery is encouraged to expedite return to normal diet and mobility. Evidence regarding oral carbohydrate loading is unclear and local hospital protocols should be consulted.

Glucogel, glucagon and rapid acting insulin should be routinely prescribed to allow prompt management of hyper or hypoglycaemia.

Variable rate intravenous insulin infusions (VRIII)

VRIIIs provide a continuous substrate for insulin in the form of a glucose-containing intravenous fluid and an insulin infusion which is adjusted to keep CBG within a pre-designated range (6 −10 mmol/l). The starting rate of insulin infusion is dependent

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on the patient's initial CBG measurement, whether they have taken long acting subcutaneous insulin and how sensitive they are to insulin. Patients who have not had any long acting insulin should not have the insulin infusion stopped as they risk DKA. Low CBG should prompt a reduction in insulin infusion rate ± a bolus of glucose, and high CBG should lead to an increase in insulin infusion ± confirmation of the reading ± ketone measurement. Intravenous insulin should never run unopposed (without a concurrent glucose substrate infusion) outside the critical care environment. The substrate fluid is a controversial topic and local guidelines should be followed. Joint diabetes guidelines recommend 5% glucose in 0.45% saline and 0.15%/0.3% potassium chloride. The glucose-containing fluid should run with the insulin through a single cannula via a Y connector with appropriate antiphon valves to prevent accidental unopposed insulin administration. An example of a VRIII regime is shown in Box 1. An alternative approach used in some hospitals is a glucose, potassium, insulin (GKI) infusion where a single bag contains glucose, potassium and insulin. It runs at a continuous rate to maintain glucose in the designated range. Bags are discarded and replaced with new bags containing higher or lower amounts of insulin as necessary.

Return to the patient's usual insulin regime must be managed carefully to avoid hospital acquired DKA. Patients can resume subcutaneous insulin once they have started eating. However, the half-life of intravenous insulin in 7–8 minutes and onset of subcutaneous insulin is longer. If the infusion is stopped too early there may be a period of insulin deficiency and ketosis may ensue. Therefore, VRIIIs should be continued for 30 minutes after the administration of subcutaneous insulin.[2]

Diabetic ketoacidosis

Diabetic ketoacidosis is a potentially life-threatening complication of diabetes. This may be the patient's presenting complaint, or may be hospital acquired as a result of poor diabetes management. It is more common in type 1 diabetics, but may also occur in insulin dependent type 2 diabetics. It is traditionally defined as hyperglycaemia, ketonaemia and acidosis;[6] however, there is a rising awareness of euglycemic ketoacidosis which must not be overlooked.

In health, insulin is released in response to raised blood glucose levels, resulting in movement of glucose and potassium into cells to provide a substrate for cellular respiration. In DKA insulin deficiency results in a failure of glucose and potassium to enter cells and a failure of inhibition of insulin's opposing hormones, which include glucagon, catecholamines and growth hormone. Further hyperglycaemia ensues via glycogenolysis, gluconeogenesis and reduced glucose usage. Despite the hyperglycaemia, the body has no access to it for cellular processes, so enters a state of intracellular starvation. In order to meet the metabolic requirements fatty acids are broken down into ketones (acetoacetate and β-hydroxybutyrate) governed by the inappropriate ratio of insulin to glucagon and other catabolic hormones. These ketones create a metabolic acidosis. Hyperglycaemia leads to an osmotic diuresis which leads to severe dehydration further contributing to the acidosis and electrolyte imbalances. Crucially the underlying metabolic disturbance is caused by insufficient insulin and hormonal imbalance. Therefore, the cornerstone of treatment is insulin replacement until intracellular metabolism is normalized and ketones are no longer produced. The end point of treatment for DKA is capillary ketones below 0.6 mmol/l and pH >7.3.[6]

Treatment of DKA is a fixed rate insulin infusion started at 0.1 unit/kg to achieve a fall in glucose of 3 mmol/l/h, an increase in bicarbonate of 3 mmol/l/h and a fall in ketones of 0.5 mmol/l/h. Fluid resuscitation and electrolyte management is imperative and must continue concurrently. When blood glucose levels drop to below 14 mmol/l a glucose infusion should be started. This enables insulin therapy to continue without hypoglycaemia, until ketosis has resolved. An example regime for the treatment of DKA is outlined in Box 2.[2]

Example management of VRIII

Single cannula with a Y connector and appropriate anti-syphon valve connected to:

- 50-ml syringe containing 50 units of soluble human insulin, e.g. Actrapid in 0.9% sodium chloride
- Substrate IV fluid, e.g. 5 Glucose in 0.45% Saline and 0.15%/0/3% potassium chloride running at a fixed rate to meet patients maintenance fluid requirements e.g. 100 ml/h

Some patients will require additional crystalloid fluids which should run via a second cannula

Start insulin at rate based on CBG and whether or not basal insulin given as per table. Consider higher insulin rates for insulin resistant patients (on >100 units/day) and reduced rates for insulin naïve patients

Hourly CBG measurements with adjustments of insulin rates as per table

Glucose (mmol/L)	Insulin infusion (units/hour)	
	No basal insulin	Basal insulin continued
<4	0.5 ml/h administer 100ml iv 20% glucose	0 ml/h and administer 100 ml iv 20% glucose
4.1–6	0.5 ml/h and consider 50ml iv 20% glucose	0ml/h and consider 50 ml iv 20% glucose
6.1–8	1	1
8.1–12	2	2
12.1–16	4	4
16.1–20	5	5
20.1–24	6	6
>24.1	8 Ensure insulin is running, and not measuring an artefact	8 Ensure insulin is running, and not measuring an artefact

In patients with type 1 diabetes VRIII should not be taken down unless subcutaneous insulin has been administered in the previous 30 minutes

Electrolytes should be measured daily

Box 1

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Example management of diabetic ketoacidosis

BC assessment and investigation of underlying trigger for DKA
Fluid resuscitation

- 0.9% NaCl 1000 ml over first hour
- 0.9% NaCl 1000 ml with potassium chloride[a] over next 2 hours
- 0.9% NaCl 1000 ml with potassium chloride[a] over next 2 hours
- 0.9% NaCl 1000 ml with potassium chloride[a] over next 4 hours
- 0.9% NaCl 1000 ml with potassium chloride[a] over next 4 hours
- 0.9% NaCl 1000 ml with potassium chloride[a] over next 6 hours

Fixed rate insulin infusion at 0.1 units/kg/h
Continue long acting insulin
IV 10% glucose infusion 125 ml/h when blood glucose <14 mmol/l
Monitor capillary ketones and venous blood gases aiming for

- Fall in ketones 0.5 mmol/l/h
- Rise in bicarbinate 3.0 mmol/l/h
- Potassium in normal range

[a]If potassium between 3.5 ad 5.5 mmol/l

Box 2

Hyperosmolar hyperglycaemic state (HHS) describes another diabetic emergency resulting from a relative or absolute insulin deficiency. It is more common in type 2 diabetics where a degree of insulin function remains. It results in severe hyperglycaemia (>30 mmol/l), dehydration and raised serum osmolality (>320 mmol/kg).[6] The onset is typically slower and results in more severe dehydration due to the higher blood glucose levels promoting greater osmotic diuresis. The treatment should start with slow rehydration. Insulin should only be used if blood glucose does not fall with rehydration or if ketones are present. These patients are also at higher risk of venous thromboembolism.

Thyroid disease

The thyroid gland is situated in the anterior neck, and is divided into two lobes connected by the thyroid isthmus. It produces two hormones: triiodothyronine (T3) and thyroxine (T4). They have numerous effector sites and exhibit control over metabolic rate, metabolism of carbohydrate and protein, and sensitivity to catecholamines. Their release is stimulated by thyroid stimulating hormone (TSH) from the pituitary. This in turn is stimulated by thyroid releasing hormone (TRH) from the hypothalamus. Negative feedback by T3/T4 inhibits the pituitary and hypothalamic hormone release (Figure 1). Dysregulation of thyroid hormones ranges from subclinical thyroid disease to thyroid crises such as thyroid storm and myxoedema coma. Thyroid emergencies should be managed in a critical care environment with endocrinologist involvement. The primary pathology can be due to lack or excess of hormones at the thyroid (primary), pituitary (secondary) or hypothalamus (tertiary) (see Figure 1).

Thyroid dysfunction is common in the general population. The perioperative period exposes the patient to physiological stress, which may cause exacerbation of underlying thyroid disease. It is therefore important to understand how to interpret clinical and biochemical features of thyroid disease and to optimise thyroid status prior to surgery, particularly in the elective setting. A TSH level should be checked in all patients with known

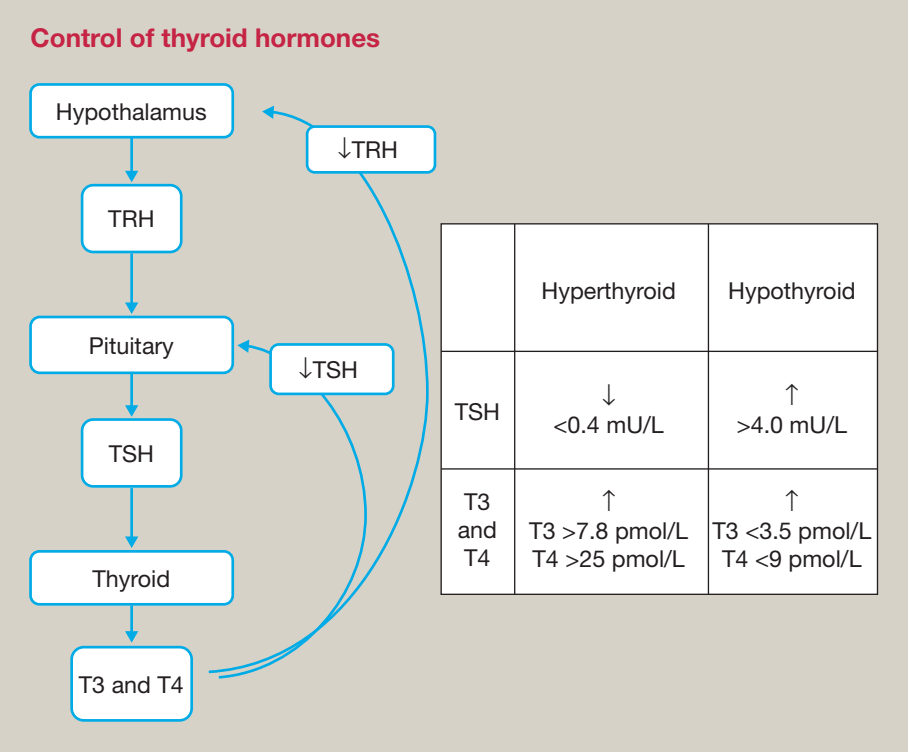

Figure 1

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or suspected thyroid disease to determine thyroid status and assess response to treatment. Patients should be clinically and biochemically euthyroid prior to surgery. In subclinical thyroid disease (TSH abnormal, normal free thyroxine), it is important to assess the patient clinically for symptoms and signs of thyroid disease when deciding whether to proceed.[7]

Hyperthyroidism

An excess of thyroid hormones results in symptoms of weight loss, anxiety, diarrhoea, tremor, heat intolerance, palpitations and sweating. Signs include tachycardia, tremor, hypertension and hyperpyrexia. A patient with primary thyrotoxicosis will have raised T3 and T4 levels and low TSH levels. Treatment involves blockade of thyroid hormone production with drugs such as carbimazole. Patients with clinical or biochemical thyrotoxicosis require treatment prior to surgery to prevent the risk of precipitating a thyroid storm.

A thyroid storm is a life-threatening state of thyrotoxicosis. It is a clinical diagnosis which may be guided by the Severity Assessment in Thyroid Crisis Score. Although levels of TSH are often undetectable, the magnitude of T3/T4 elevation does not correlate with disease severity. Criteria include pyrexia, tachycardia, cardiac failure, altered GCS and abdominal symptoms. It can be precipitated by physiological stress (e.g. sepsis, surgery), or overdose of thyroid hormones. Treatment usually includes beta blockade to oppose adrenergic effects, followed by consideration of medications that prevent synthesis of thyroid hormones. These include as thionamides, propothyrouracil and carbimazole, and other medications such as steroids that limit peripheral conversion of T4 to T3. Patients also require fluid resuscitation and cooling, and treatment of the precipitating cause.

Hypothyroidism

Lack of thyroid hormones results in myocardial and respiratory depression, anaemia, hypoglycaemia and impaired drug metabolism. Symptoms include weight gain, low mood, fatigue, constipation and hypothermia. Biochemically, patients have a low T3 and T4 with a raised TSH. Treatment involves replacement of thyroid hormones with levothyroxine. Patients should be euthyroid prior to any elective surgery to prevent precipitation of myxoedema coma or unpredictable drug metabolism. Myxoedema coma describes a picture of decreased mental status and hypothermia alongside clinical features of hypothyroidism. Mortality is quoted as 30–60%. Thyroid hormone replacement is usually achieved intravenously to avoid unpredictable absorption. T4 has a longer half-life and slower onset than T3, but in some instances the fast onset of T3 may precipitate myocardial ischaemia or adrenal insufficiency. Expert advice should be sought.

In addition to the physiological and metabolic disturbances of thyroid hormone imbalance, thyroid disease may also present with symptoms of mass effect with or without endocrine abnormality. This can be immediately life threatening. Patients with a goitre may require an anaesthetic/ENT airway review. A goitre may be malignant or benign, cause mass effect or invade local structures. Signs and symptoms of impending or current airway compromise include voice change, difficulty swallowing, difficulty lying flat, stridor, shortness of breath, hypoxia, rising CO_2, agitation or exhaustion. This could be due to compression of the airway or compression or infiltration of the recurrent laryngeal nerve.

Adrenal dysfunction

The adrenal glands are bilateral endocrine organs situated on the superior poles of the kidneys. Anatomically and embryonically they comprise two discrete zones: (1) the central medulla that secretes catecholamines as part of the sympathetic response; and (2) the outer cortex which secretes three classes of steroid hormones - androgens, glucocorticoids and mineralocorticoids.[8]

Glucocorticoids, cortisol and corticosteroid, are essential components of the body's response to stress and fasting. They cause protein catabolism, gluconeogenesis and antagonise insulin. They also stimulate production of adrenaline and maintain tissue responsiveness to catecholamines. They have a weak mineralocorticoid effect, and can cause immunosuppression and delayed wound healing in large doses.[8]

The principal mineralocorticoid is aldosterone, which causes increased sodium levels via increased renal reabsorption. This in turn causes an increase in water reabsorption and thus circulating volume. Aldosterone also promotes renal loss of hydrogen ions and potassium.

The hypothalamic pituitary axis controls glucocorticoids and mineralocorticoids. The latter is also regulated via the renin angiotensin system via changes in blood pressure and electrolytes. A fall in sodium, rise in potassium, fall in renal perfusion and increase in angiotensin 2 will cause an increase in aldosterone production (Figure 2).

Cortisol excess can be due to excess cortisol production by the adrenal glands (primary) or stimulated excess via excess ACTH production from the pituitary or an ectopic site (secondary). Excess cortisol causes hypertension, increased blood sugars or diabetes mellitus, hypokalaemia, muscle wasting and central obesity. Excess aldosterone, as occurs in Conn's disease, results in hypernatraemia, hypokalaemia, hypertension and alkalosis.

Eighty per cent of cases of adrenal insufficiency are due to Addison's disease, an autoimmune mediated destruction of the gland. Other causes include haemorrhage, infection or carcinoma. In these pathologies reduced levels of both glucocorticoids and mineralocorticoids will occur. Features of an acute presentation include abdominal pain, dehydration, hyponatraemia, hyperkalaemia and hypotension. Fluid resuscitation and steroid replacement is essential, one regime describes 200 mg hydrocortisone IV or IM as an initial dose followed by 100 mg 6-hourly until oral supplements can be taken. Intravenous glucose may also be required and critical care should be considered early.

Cortisol deficiency can also occur with prolonged use of exogenous steroids. The exogenous steroid negatively feeds back on the hypothalamus and pituitary and results in a failure of the adrenal gland to produce steroids in response to stress (see Figure 2). Any patient taking the equivalent of 5 mg of prednisolone long term is at risk of adrenal axis suppression and should be treated as such.[9]

Diagnosis of adrenal insufficiency is made using a short synacthen test. Synacthen is a synthetic analogue of ACTH so should suppress cortisol production. Initial cortisol levels are taken followed by synacthen IV or IM. Thirty and 60 minute cortisol levels

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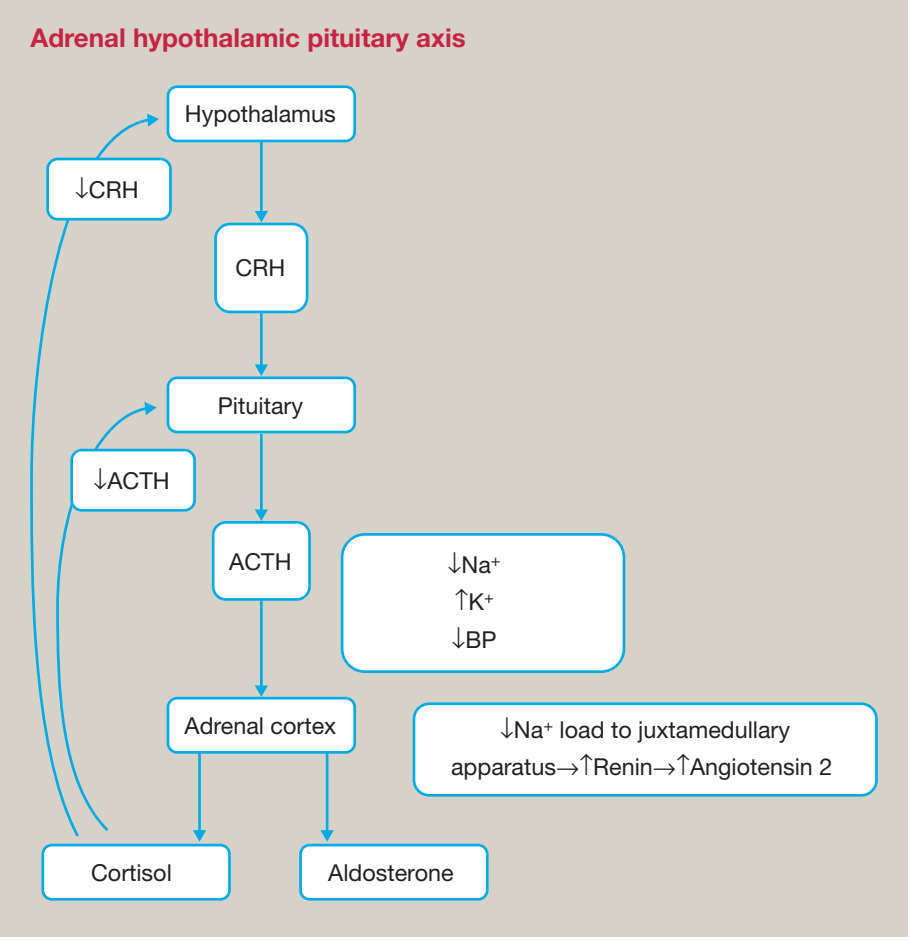

Figure 2

are measured. A low initial cortisol level with inadequate suppression occurs in adrenal insufficiency.

Perioperatively patients with adrenal insufficiency require steroid replacement, plans to minimize fasting and dehydration and appropriate fluid resuscitation. Patients should be first on the list to prevent excessive dehydration and hypoglycaemia.[9] The steroid replacement regime depends on the nature of the surgery and local guidelines should be consulted.

Phaeochromocytoma

Phaeochromocytomas are rare catecholamine releasing neuroendocrine tumours that arise from chromaffin cells of the adrenal medulla. Most are benign and unilateral. They occur in less than 0.2% of patients with hypertension, and classically present with symptoms of headache, palpitations and sweating.

Due to the short half-life of catecholamines in the serum diagnosis is made by measuring serum or urine levels of catecholamine breakdown products such as vanillylmandelic acid (VMA). A CT scan will identify the tumour in the majority of cases, but MRI or functional imaging such as scintigraphy may be required to identify extra adrenal paragangliomas or metastases.

In addition to routine preoperative investigations an echocardiogram is required to assess for left ventricular dysfunction, most commonly diastolic dysfunction. End-organ dysfunction should be considered, and electrolyte disturbances and hyperglycaemia must be treated. A senior anaesthetist familiar with the condition should be involved in the preoperative management.

Preoperative medical treatment options for phaeochromocytoma commonly includes the administration of alpha adrenoceptor blocking agents such as phenoxybenzamine (non-selective) or prazosin (selective) followed by cardio-selective beta blockade such as metoprolol or atenolol for management of hypertension. Beta blockers should never be initiated prior to initiation of alpha blockade in patients with functional tumors as suppression of beta 1 mediated cardiac sympathetic drive can lead to acute cardiac insufficiency and pulmonary oedema.[10]

Due to excess catecholamine secretions and adrenergic stimulation, phaeochromocytomas can lead to major life-threatening complications. These include widespread cardiovascular manifestations such as arrhythmias, haemodynamic instability, widespread vasoconstriction with end organ effects, malignant hypertension, stroke, myocardial ischaemia and cardiac failure.[10] Postoperatively, critical care provision should be available.

Up to 50% of hospital deaths due to phaeochromocytoma occur during operative procedures for other pathology or during induction of anaesthesia. Mortality is high in perioperative acute crisis. In the acute situation, the medication used will depend on the availability of the medication in the hospital or region. Phentolamine or urapidil infusions are accepted agents for acute management.

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Conclusion

Endocrine disease is common amongst surgical patients. Timing of surgery for these patients is an important consideration. The benefits of optimizing the endocrine pathology against the risks of delaying surgery with the potential for progression of surgical pathology should be considered. In urgent surgical cases, when there is not time to optimize the endocrine condition further, it is imperative that the clinicians have a good understanding of, and are alert to, potential complications to ensure patients remain as safe as possible throughout the perioperative period. ◆

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