Physiol-09A10 Describe the physiological effects of the glucocorticoids.

Background

Glucocorticoids = steroid hormones released from zona fasiculata in adrenal cortex

The main glucocorticoid = cortisol (95%) and corticosterone (< 5%)

Cortisol is:
- synthesised from cholesterol
- 96% plasma protein bound
- diurnal variation (peaks early morning)

Mechanism of action

Glucocorticoids diffuse into cell → bind cytosolic glucocorticoid receptors → act as transcription factor → alter gene transcription → alter protein synthesis → exert variety of physiological effects

Physiological Effects of Glucocorticoids

(1) Metabolism
Glucocorticoids exert anti-insulin effects:
- Carbohydrate – ↑hepatic glycogenolysis + gluconeogenesis, ↑peripheral insulin resistance
- Protein – ↑protein catabolism (esp. in muscle)
- Fat – ↑lipolysis, ↑ketone body formation
- Bone – ↑resorption
∴ overall → ↑plasma glucose, lipid and ketone body levels

(2) Permissive Actions
Small amount of glucocorticoid must be present for other hormones to exert their clinical effects:
- glucocorticoids required for glucagon + catecholamines to exert their calorigenic effects during hypothermia
- glucocorticoids required for catecholamines to exert their vasopressor, lipolytic and bronchodilation effects

(3) Feedback Inhibition
Glucocorticoids act on hypothalamus and pituitary to inhibit the release of CRH and ACTH
∴ feedback regulate its own production

(4) CNS Effects
Glucocorticoids are responsible for concentration
Glucocorticoid deficiency → irritability + inability concentrate

(5) Water Metabolism
Glucocorticoids are responsible for controlling renal handling of body water
Glucocorticoid deficiency → body unable to excrete free water load
(6) Haematological Effects
- increase RBC, platelet and neutrophil secretion
- decrease eosinophil, basophil and lymphocyte secretion

(7) Anti-Inflammatory Effects
- inhibit phospholipase A2 → inhibit arachidonic acid pathways → ↓ prostaglandin, ↓ thromboxane, ↓ leukotrienes
- ↓ NF-κB → ↓ cytokine release
- these prevent over-activation of inflammatory response

(8) Fetal Effects
Glucocorticoids accelerates maturation of lung surfactants

(9) GIT Effects
↓ Prostaglandin synthesis + ↑ acid and pepsin production → ↑ peptic ulcers

Examiner’s Comments – 18% of candidates passed this question.

Points that were expected to be included: An opening statement including a definition, origin of and a statement that glucocorticoids are catabolic in nature
Candidates who organised their answer into categories such as:
• Metabolism (and then broke this down to: Carbohydrate, Fat and Protein)
• Inflammation
• Effect on Foetus
• Other systems (Haematological, GI, Musculoskeletal etc)
demonstrated a global understanding and scored well

Candidates should note that neither Insulin nor glucagon are glucocorticoids and that Glucose cannot be derived from Fatty Acids
Extra marks were given for describing the actions of glucocorticoids on an intranuclear receptor and mRNA transcription and the anti inflammatory effects