BIOP211 – Pharmacology
Session 9 Drugs Affecting the Endocrine System

- Actions of individual corticosteroids across body systems and disease states
- Multiple roles of paracetamol across body systems and disease states

9.1 Discuss these pharmaceutical medications.

- Glucocorticoids
- Sulphonyl ureas and biguanides (oral hypoglycaemics)
- All formulations of insulin
- Thyroxine and liothyronine (drugs used in hypothyroidism and other indications)
- Thioureas (also called thioamides) e.g. carbimazole, propylthiouracil (drugs used in hyperthyroidism)

Your answer should cover the following:

- Examples and indications
- Mechanism of action
- Efficacy and limitations or cautions / contra-indications
- Adverse effects and drug interactions with nutrients and herbs

Mark your own answers using the Pharmacology text or online resources. Alternatively, peer review each other’s answers, allocating 10 marks per drug class.

Case Study for Session 9 post your answers on the Loop or discuss in class.

9.2 Paracetamol anti-pyretic and analgesic: is it a non-steroidal anti-inflammatory or not?

Tammy, a 15 year old, elite netball player twisted her right ankle. R.I.C.E. therapy was implemented however her ankle remained swollen and was very painful. She has National Titles in 2 weeks and needs to minimise the swelling as quickly as possible.

a. What Classes of drugs may be prescribed to her?

b. Name two (2) examples in each possible class and state the mechanism of action of the class (and give details relevant to each of your examples).

c. Which drug class is “use with caution” in this client and why? Research Reye’s syndrome and then state the drug which is contraindicated in this client.

d. What adverse effects may Tammy experience with the administration of these drugs? Give some strategies to avoid this.

e. Would paracetamol be an appropriate drug of choice for her and give a rationale for your answer?
9.3 Research the corticosteroids that act principally as glucocorticosteroids. Use your text or other online resources.

**Answer true or false.** Where a suggested answer has been given, check this with an Anatomy and Physiology text, Pharmacology or Natural Medicine text. Feedback is available on the Subject Website, Review Quiz 9

1. Glucocorticoids promote wound healing. 

2. Corticosteroids are used for a wide range of disorders including skin infection. 

3. In a normal physiological state, stress adaptation involves both the adrenal medulla and the adrenal cortex. 

4. Dexamethasone is immunosuppressive and used where there is pressure on a nerve causing swelling, redness, pain (inflammation). 

5. A patient is prescribed two inhaler medications for asthma management. When using inhaled corticosteroids, they should be used after using the bronchodilator inhaler. 

6. Glucocorticoids may increase the potential for digoxin toxicity. 

7. The withdrawal of glucocorticoid treatment for those receiving long-term therapy should always be gradual.

For the following questions, discuss the terms, drugs, adverse effects and the suggested answer or check the answer in an Anatomy and Physiology, Pharmacology or Natural Medicine text:

8. Corticosteroid treatment is best divided two thirds in the morning and one third at night.  
   **True, mimics natural rhythm** 

9. The stimulus for corticosteroid production is pituitary corticotropin  
   **True, review the pituitary-adrenal axis** 

10. The primary function of mineralocorticoids is to regulate sodium and potassium balance but there will be minimal effects on carbohydrate metabolism  
    **True, even glucocorticoids have some residual mineralocorticoid actions, hence adverse effects of steroids.**
11. The synthesis of mineralocorticoids (e.g. aldosterone) by the adrenal cortex is under the control of angiotensin II and adrenocorticotropic hormone (ACTH).

   True. Review the RAAS. Aldosterone is the main mineralocorticoid. It is under the control of both ACTH and the renin / angiotensin system, particularly angiotensin II.

12. In carbohydrate metabolism, glucocorticoids increase gluconeogenesis

   True. Glucocorticoids produce hyperglycaemia by decreasing glucose uptake into cells and decreasing glucose utilisation, while increasing gluconeogenesis.

13. Plasma glucose levels are decreased by the action of mineralocorticoids.

   False, mineralocorticoids reduce plasma potassium levels. Even if they have residual glucocorticoid action, this would increase plasma glucose levels.

14. Dexamethasone is a steroid compounds that has high glucocorticoid potency but little mineralocorticoid potency.

   True, Hydrocortisone and cortisone have some residual mineralocorticoid action. Fludocortisone has some residual glucocorticoid action but tends not to at the low doses that are used.

15. Glucocorticoids do not increase the bone-building activity of osteoblasts.

   True, they also increase osteoclast activity, decrease in calcium absorption and increase in calcium excretion. Hence a reason to avoid long term use of corticosteroid is so as to avoid bone density depletion.

16. Glucocorticoids stimulate the production of lipocortin mediator

   True, summarize the physiology

17. An excess of corticosteroids is called Cushing's syndrome, while a deficiency of corticosteroids is called Addison's disease

   True. Summarize the pathophysiology

**Summary – Drugs used in hypothyroidism and hyperthyroidism, DM types 1 and 2 and Corticosteroids**

- Thyroxine hormonal replacement therapy, thyroxine HRT is needed in both hyperthyroidism & hypothyroidism. Unique to hyperthyroid disorders: Need for antithyroid treatments before hormone replacement therapy. Anti-thyroid treatments to render the person euthyroid are varied but concentrate on pharmaceutical preparations in your Drug Diary, such as propylthiouracil and carbimazole (thioamides also called thioureas) in the treatment of thyroid dysfunction. Then discuss how the euthyroid status is maintained using thyroxine HRT. Need for monitoring especially cardiac monitoring and TSH levels. Liothyronine (T3) for emergency.

- Insulin, biguanides and sulfonylureas for the treatment of Diabetes Mellitus. Formulations and onsets of action, insulins. Obesity and choice of oral
hypoglycaemics: metformin can be used in people who are obese; glibenclamide should not be used in the client who is obese as there will be a weight gain. Know general features of insulins and oral hypoglycaemics and how lifestyle management is integral to drug treatment.

- Corticosteroids and their pharmacological effects: review immunosuppressant and anti-inflammatory modes of action; many adverse effects including metabolic, CNS. Dosage especially in chronic use (use in asthma will be reviewed again in Session 13 Drugs Affecting Respiratory Diseases).

Reference List


Additional Resources

Textbook Location, other readings and text questions


Research: The Endocrine Pancreas and Management of Diabetes Mellitus

Research: Drugs Affecting the Endocrine System, Overview of the Hypothalamus-Pituitary Axis, Pituitary and Endocrine System, The Thyroid Gland and Antithyroid Drugs, The Adrenal Cortex (General Aspects of the Adrenal Glands and Glucocorticoids), Review also the Unit “Drugs Affecting the Endocrine System” In the section called “Hormones and Drugs Affecting Bone”, Read the section on Corticosteroids only. In the section called “Pharmacology of the Adrenal Cortex”, Read “Glucocorticoids”

In “The Thyroid Gland and Antithyroid Drugs” concentrate on questions on synthesis of T3 and T4, thyroid hormones when used clinically as drugs, thionamide derivatives and iodine, hypo- and hyper-thyroid disorders
In “Pharmacology of the Adrenal Cortex” concentrate on questions on immunosuppressant and anti-inflammatory actions of glucocorticoids but do the review of the three types of steroid hormones.

In “The Endocrine Pancreas and Management of Diabetes Mellitus” concentrate on questions on the role of insulin in regulating blood glucose levels, human insulin, formulations and regimens for administration of insulin, choosing between sulfonyl urea agents in treating type 2 DM, MoF of oral hypoglycaemics.

For case study questions see:

- From Endeavour LMS subject website, review quiz and Case Study ( Drugs in Sport and Adulscence). Check this historical document available from the TGA website: http://www.tga.gov.au/archive/review-aspirin-reyes-syndrome-0404.htm
- If you find other educationally-useful videos, add them to the Loop / forums

Revision Questions / Activities from the Reading Guide:

1. Review the roles of TSH and ACTH in the hypothalamus-pituitary-target organ axis.

2. Name the two main thyroid hormones, state their physiological actions. Their role as drugs in hormone replacement therapy, hypothyroidism and hyperthyroidism will be discussed in the tutorial activities.

3. Discuss hyperthyroidism and the goals of treatment: Briefly discuss pharmacotherapy to achieve the euthyroid state with use of antithyroid drugs (thioureas and radioactive $^{131}$I), TSH levels in euthyroid state, then use of hormone replacement therapy T4. Some of these will be discussed in detail in the tutorial activities.

4. Review the action of glucocorticoids on the target (receptor in cytoplasm, DNA/mRNA) and effect on COX-2 synthesis, collagenase synthesis, synthesis of anti-inflammatory mediators. In the tutorial activities the pharmacotherapy role in anti-inflammation, immunosuppression, action on histamine, prostaglandins and leukotriene production will be discussed as well as explaining the ADR eg paper-thin skin (effect on collagenase synthesis).

5. Summarize the ADR of glucocorticoids (especially type C, chronic use) under these headings: cushingoid effects on metabolism; suppression of hypothalamus-pituitary-adrenal axis; effects of their mineralocorticoid actions; musculoskeletal abnormalities.

6. Discuss the need to avoid use of glucocorticoids in children, local administration to avoid ADR, alternate day dosage regimens and avoiding > 4 weeks use, avoiding abrupt withdrawal and titrating doses.

7. Why is insulin life-saving in the treatment of type 1, some people with type 2 and type 3 (gestational) diabetes? The use of short-acting, intermediate and long acting insulin formulations and other pharmaco-therapeutic aspects will be covered in the tutorial activities.

8. Discuss the reasons for choice of metformin (a biguanide) versus a sulphonylurea (e.g. glibenclamide) in DM type 2. The pharmaco-therapeutic aspects of these two oral hypoglycaemic sub-classes will be discussed in the tutorial activities.