**MCD Tutorial 5 – Anaphylactic reaction**

**Take home notes**

Anaphylaxis is an acute (i.e. immediate) type I hypersensitivity reaction that can be systemic, and is sometimes so overwhelming that it is life-threatening. It results from an IgE-mediated response to an allergen that is present throughout the body.

**Immunoglobulin E (IgE)**

The IgE response is thought to be important in defence against certain parasitic infections (e.g. nematodes). However it can occur inappropriately to give rise to allergic reactions. The normal pathway of lymphocyte activation occurs where antigen binds to the surface IgM on B lymphocytes to stimulate proliferation and secretion of antibody. Usually the antibody initially secreted is IgM, and this switches to IgG as the immune response progresses. In type I hypersensitivity, activation of CD4+ T helper cells (TH2) causes a switch to IgE production.

*You may wish to use this opportunity to revise the structural differences and functions of the different immunoglobulin classes*.

IgE becomes bound to specific binding sites (IgE-specific Fc receptors) found on the surface of mast cells, and it is the subsequent stimulation of these cells by exposure to the antigen that causes allergic or anaphylactic responses. An antigen that causes an allergic type of IgE-mediated response is often known as an **allergen**.

**Mast cells**

Mast cells are widely distributed throughout the body both in connective tissue (e.g. under the skin) and in association with epithelial mucosae (e.g. the respiratory and intestinal epithelia). They contain prominent granules which contain a number of mediators of inflammation, notably histamine and leukotrienes. These are secreted following antigen binding to the cell surface IgE.

The inflammatory mediators released by mast cells act principally on blood vessels and smooth muscle. In connective tissue histamine causes dilatation of vessels with increased blood flow to the surface and increased movement of fluid out of the blood stream (oedema). Around mucosae the opposite effect occurs, causing constriction of airways and contraction of the smooth muscle in the walls of the intestines.

The net effect depends on whether the stimulation is local or systemic.

**Skin allergy**

If the patient has a skin allergy, stimulation of connective tissue mast cells causes vasodilatation leading to the red colour of the skin rash, and oedema leading to its raised appearance. This type of rash is often called **urticaria**, and is familiar as the pattern of rash caused by stinging nettles. The localised skin reaction is used in allergy testing, where small amounts of possible allergens are injected by pin-prick to see if they cause this kind of localised **wheal-and-flare** reaction.

Substances known to be capable of causing skin allergies include animal hair, proteins in natural latex, certain chemicals, substances in insect and plant stings.

**Hay fever and asthma**

If the allergen is inhaled, the principal site of action will be mucosal mast cells of the respiratory system. If this is principally in the nasal passages, the effect will be oedema in the epithelia lining the nose and a consequent general irritation including stimulation of mucus secretion. It is the allergic reaction which causes hay fever (allergic rhinitis). If the allergen reaches the bronchioles of the lungs then there will be contraction of smooth muscle reducing the diameter of the airways, as well as inflammation and increased mucus production. The result is asthma, with difficulty breathing in and (especially) breathing out.

Substances known to be capable of causing hay fever and asthma include pollens, faeces of dust mites, and proteins from animal hairs.

# Food allergies

If the allergen is ingested, then it will act at mucosal mast cells in the intestinal tract. The stimulation of the associated smooth muscle leads to the vomiting and diarrhoea typical of a food allergy. If the allergic substance can be absorbed and pass into the blood stream it may also cause skin symptoms (rashes or itching).

Substances known to be capable of causing food allergies include peanuts and other nuts and legumes (e.g. soya), shellfish, milk, eggs, wheat.

**Anaphylaxis**

Anaphylaxis results from a systemic response to the allergen, causing immediate responses throughout the body. Though not common it is potentially fatal and must be treated as a medical emergency. Dilatation of peripheral blood vessels causes symptoms of rashes and oedema, but more importantly it results in a dramatic drop in blood pressure which can affect organ function: this is known as **shock**. Constriction of bronchi causes difficulty in breathing. The patient will respond with an increase in both respiratory and heart rates. There may also be symptoms of nausea, abdominal cramps or diarrhoea from the effects on the intestines.

Emergency treatment is aimed initially at the loss of blood pressure (**hypotension**), and then at the underlying inflammation. The patient is lain down with feet raised in order to improve blood supply to the head and trunk. An injection of adrenaline will act to constrict peripheral blood vessels and redirect blood to the organs. An intravenous drip may also be used to control blood pressure. Medications that may be used subsequently include antihistamines and anti-inflammatory corticosteroids. If breathing problems persist oxygen may be necessary and bronchodilators may be given via an inhaler.

Substances which can cause anaphylaxis in susceptible patients are those which can pass freely around the body.

* Penicillin, especially if it has previously been given intravenously
* Certain other drugs (e.g. local anaesthetics, X-ray contrast agents)
* Venom in bee or wasp stings
* Peanuts – the allergen can be absorbed fast enough to cause systemic effects

Long term treatment is largely by avoiding known allergens. For those difficult to avoid completely (such as wasp stings, or nuts where small traces may contaminate apparently innocent foods) the patient may be given adrenaline in a self-injection “pen” to carry in case of emergency, as well as a “Medic alert” bracelet to wear to alert health care professionals.