Pathophysiology and pharmacological management of asthma from a nature-nurture perspective

PHC725 **Clancy J, Blake D** (2013) Pathophysiology and pharmacological management of asthma from a nature-nurture perspective *Date of submission:* November 21 2012. *Date of acceptance:* March 27 2013.

Abstract

The maintenance of health depends on nature (associated with genes) and nurture (associated with lifestyle and living conditions) interactions at an intracellular chemical level. Asthma is a common, chronic lung disease affecting more than five million people in the UK, but there is uncertainty about the development of this disease. This article will discuss the pathophysiology of asthma as a cellular or chemical homeodynamic imbalance of inflammation and bronchial hyperactivity. Understanding of such imbalance supports the pharmacological rationale of treatment. The article will explore what has been discovered to date through human genomic research, introduce some of the theories associated with the development of asthma from a nature-nurture perspective and highlight potential developments in the diagnosis and management of the condition.

Aims and intended learning outcomes

The aim of this article is to enable readers to review their understanding of the nature and aetiology of asthma, sufficient to support their work with pharmacological treatments of the condition and to answer potential questions from patients or other clinicians. After reading the article and completing the time out activities you should be able to:

- Briefly summarise what happens physiologically when an asthma attack is triggered.
- Review with patients their perceptions of what causes asthma and what helps to manage the problem.
- Share with patients a clearer rationale of why particular drugs are therapeutic.
- Assist patients to re-evaluate what is involved in managing their condition (sustaining homeodynamism).

Introduction

An estimated 5.2 million people in the UK have asthma, making its prevalence one of the highest of any country in the world; on average asthma affects people in one of five UK households and is responsible for one hospital admission every 7.5 minutes (Asthma UK 2011).

The National Institute for Health and Care Excellence (NICE) (2008) reported 1,266 asthma-related deaths in 2004.

Now do time out 1

1 Description of asthma

Time out

The reflective activities associated with this article centre on an asthma care case that you are familiar with and which may have posed some difficulties, either in terms of treatment or of helping patients to understand what is happening. Jot down a paragraph outlining the patient's circumstances as you remember them and what seemed challenging. Pay attention to how the patient defined his or her asthma and note the treatment prescribed.

The World Health Organization (WHO) (2012) defined asthma in terms of its symptoms as 'a disease characterised by recurrent attacks of breathlessness and wheezing which vary in severity and frequency from person to person'. The British Thoracic Society

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Keywords

Asthma, environmental triggers, allergens, Human Genome Project, beta-2 adrenergic receptors, beta-2 agonist bronchodilators, hygiene hypothesis

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Conflict of interest
None declared

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and Scottish Intercollegiate Guidelines Network (BTS) guidelines (2012) suggested that 'central to all definitions is the presence of symptoms (more than one of wheeze, breathlessness, chest tightness and cough) and of variable airflow obstruction'. However, these definitions may be considered somewhat dated.

Historically, it was thought that the basic defect in asthma was an abnormality of airway smooth muscle contractility, resulting in the symptoms described above. The authors now realise that, regardless of the disease severity, an underlying chronic inflammation of the airways is present in patients. It is something of a paradox that in the two credible definitions associated with the disease given here the term 'inflammation' is not present.

A more up-to-date definition is provided by NICE (2008): 'Asthma is a chronic disorder of the airways, which is predominantly caused by the inflammatory response and bronchoconstriction brought about by various environmental stimuli, such as: environmental temperature, smoke, allergens, respiratory infections, exercise, mould, animal fur, pollen and house dust mites.' Alongside insight into the inflammatory nature of asthma, consideration needs to be given to the nature of cellular change in the respiratory system (the homeodynamics). Theories that have been used to explain asthma, such as the hygiene hypothesis, outlined below, need to be reconsidered as part of a rationale for treatment.

Now do time out 2

2 Description of asthma

Time out

Revisit your case study and determine how the patient has described his or her asthma. Has 'inflammation of the airways' been used in the explanation, or does the patient instead talk about bronchial spasm? Understanding a patient's perception of illness is essential to building more effective discussions of treatment.

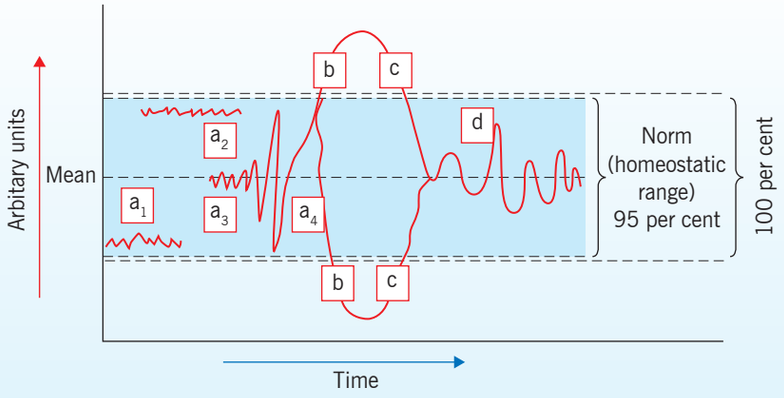
Homeodynamic responses to allergens

Most physiologists find the terms 'health/homeostasis' and 'illness/homeostasis' imbalances interchangeable in that they operate at a cellular level; cells are regarded as the 'basic unit of life' and are responsible for maintaining stability of body fluids (Clancy and McVicar 2009). However, the appropriateness of the term 'homeostasis' had been challenged by Clancy and McVicar (2011a) because 'homeodynamism' appears to offer a richer understanding of individual subjectivity regarding clinically defined 'normal' values associated with human health.

Receptors detect a homeodynamic chemical disturbance, and relay this information to the homeodynamic control centre(s) (Figure 1). It is here that the severity of the deviation, for example how far is it above or below the homeodynamic range, is assessed. The control centre or centres then stimulate appropriate responses – usually a negative feedback – via effectors to correct the disturbance and normalise the chemical parameter. Since illnesses are homeodynamic imbalances of either an excess or deficiency of a chemical product of metabolism, it follows that an imbalance is a failure of receptor and/or homeodynamic control centre and/or effector functioning (Clancy and McVicar 2011a, 2011b).

Knowledge of this process is fundamental for the primary healthcare practitioner when caring for patients with asthma. A clear understanding is needed of normal functioning of the airways and the immunological response to allergens to explain the pathophysiology of asthma and secondary homeodynamic imbalances that may accompany this disease.

Figure 1 Principles of homeodynamic control



a1-4: Homeodynamism – values fluctuating within the homeodynamic range, reflecting individual variation within the population. (b) Homeodynamic disturbance – value parameters moves outside the homeodynamic range. (c) Homeodynamic mechanisms – receptors, homeodynamic controls, genes, effectors, enzymes, pH, adenosine triphosphate restore homeodynamism, usually by negative feedback mechanisms. (d) Homeodynamism re-established.

Homeodynamic graph Re: respiratory function. Arbitrary units could be labelled bronchial activity so labels (a_{1-4}) indicate healthy and normal bronchial activity demonstrating individual variation within the population. (b) Indicates temporary increases and/or decreases in bronchial activity due to life-events or environmental triggers. (c) Indicates the natural homeodynamic responses of the body to correct the disturbance. (d) Indicates that normal bronchial activity has been re-established.

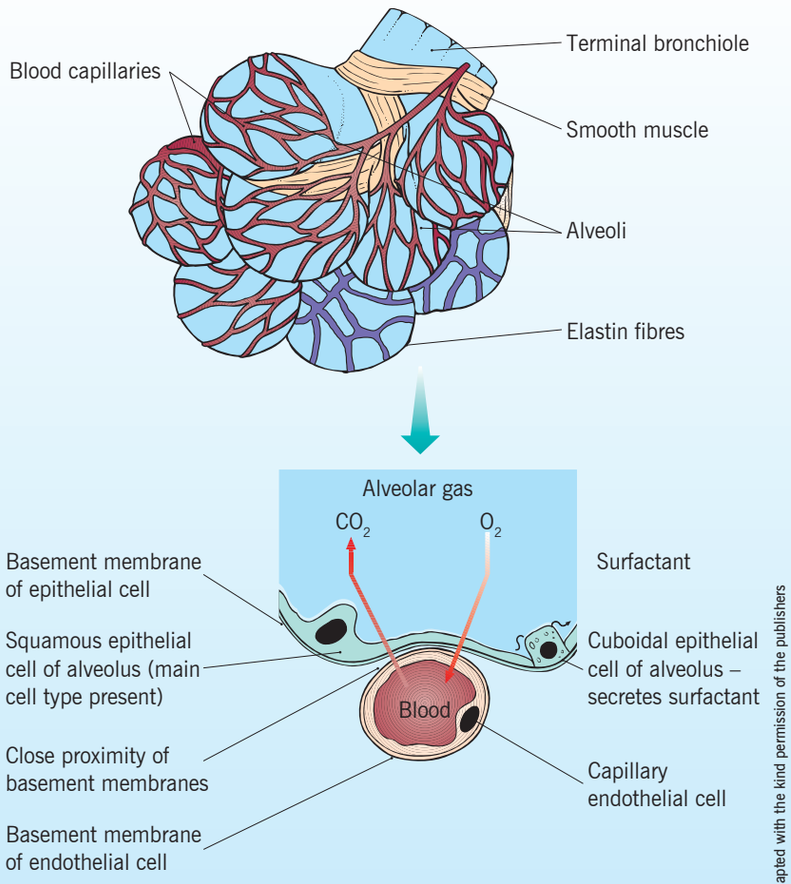
(Clancy and McVicar 2009)

Pathophysiology of asthma and drug interaction

The respiratory airways:

- Supply optimal oxygen levels for cellular respiration to provide energy in the form of adenosine triphosphate (ATP) – a chemical that drives chemical reactions (metabolism) of the body and heat to thermoregulate body fluids to optimise enzymatic function.

Figure 2 **Lungs: alveoli alveolar – capillary membrane**



(Clancy and McVicar 2009)

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- Excrete excess carbon dioxide (and water) from the body to prevent an acidosis that would reduce enzyme activity at the detriment to the individual's health (Clancy and McVicar 2009).

Chronic asthma is associated with chronic inflammation and is included under the 'umbrella' term of chronic obstructive pulmonary disease (COPD) (Clancy and Nobes 2011), in which the metabolism and health of the body are compromised because of the disease's association with hypoxia, hypercapnia and acidosis. It is the inflammation and increased contraction of the bronchial smooth muscle that cause individuals with asthma to become symptomatic.

Two sets of smooth (involuntary) muscle fibres wind down as a double spiral in between cartilages of the 'bronchial tree' (Figure 2). When these muscles contract, the airways become shorter and narrower and the epithelial mucosal lining of the airway is forced into folds; the sharp contraction of the bronchial smooth muscle in individuals with asthma is called 'bronchospasm' (Education for Health 2009).

The involuntary or autonomic nervous system controls the contraction and relaxation of the bronchial muscle. Parasympathetic stimulation results in contraction of the bronchial muscle and increased mucus secretion, while sympathetic stimulation causes relaxation of the muscle by stimulating the membrane's adrenergic receptors of bronchial muscle cells; these bind to the sympathetic neurotransmitters noradrenaline, adrenaline and dopamine. The pharmaceutical industry uses this knowledge base of neurotransmitter-receptor linkage to develop drugs that mimic the action of neurotransmitters, activating sympathetic receptor sites or blocking parasympathetic receptor sites, thereby bringing about bronchodilation.

Now do time out 3

3 Severity of the condition

Time out

Return to your case study patient and recall what they he or she said about their asthma, whether it is sometimes present, or is always there but sometimes worse, for example during bronchospasm. Why do you think insights into the chronic inflammatory nature of asthma may be important to treatment?

Adrenergic drugs, such as salbutamol, a sympathetic agonist (British National Formulary 2012) stimulate the adrenergic nerves directly by mimicking the action of noradrenaline or indirectly by stimulating the release of adrenaline and noradrenaline from the adrenal medulla (Ophardt 2003). Consequently, by mimicking the sympathetic neurotransmitters these short acting beta-agonists activate the receptors that relax bronchial smooth muscle and increase the diameter of the airways, which in turn will relieve the symptoms of asthma.

To understand fully how sympathetic agonists work and why potential side effects may arise, it is important to provide an overview of the sympathetic receptors on which drugs act. Sympathetic receptors include: alpha-1 and 2, and beta-1, 2, 3 and 4 receptors, beta-2 receptor being the most common in the lungs (Education for Health 2009).

The existence of receptor sub-types makes it possible to target drugs more specifically to stimulate or block specific types of receptor (Education for Health 2009). For example, a selective beta-2 agonist, such as salbutamol, is more specific than a non-selective beta agonist, such as adrenaline, at relaxing bronchial smooth muscle with less unwanted side effects, such as palpitations.

The identification of these receptors explains why an individual with asthma should not be prescribed non-selective beta blockers, because they will target beta-1 receptors associated with the conduction system of the

heart, and have an undesired effect on beta-2, commonly found in the respiratory airways.

Parasympathetic nervous system receptor sub-types are being researched, but at present their relevance to asthma treatment is not understood (Education for Health 2009). We are aware, however, that cholinergic receptors of the parasympathetic nervous system cause contraction of the bronchial smooth muscle and increased secretion of mucus in the respiratory tract in response to vagal nerve stimulation. It follows that parasympathetic cholinergic-blocking agents such as ipratropium bromide (British National Formulary 2012) prevent the neurotransmitter acetylcholine from stimulating the receptor site, thus preventing bronchial smooth muscle contraction.

Inflammation and bronchial hyperreactivity

Asthma is often associated with the term 'atopy', or a hereditary allergic condition. However, not all cases of asthma are atopic. For example, intrinsic asthma, more commonly found in adults, arises from factors such as physical exertion and psychological issues such as anxiety or stress. This article will focus on 'atopic' and external factors associated with the development of asthma. Atopy is characterised by the production of specific antibodies called immunoglobulin (IgE) in response to common environmental allergens, that is specific antigens that cause an allergic reaction such as house dust mites, moulds, pollens and minute scales from animal hair, feathers or skin. Antibodies are produced to maintain homeodynamism, or to re-establish the homeodynamic status for the patient following an allergic reaction (Clancy and McVicar 2009).

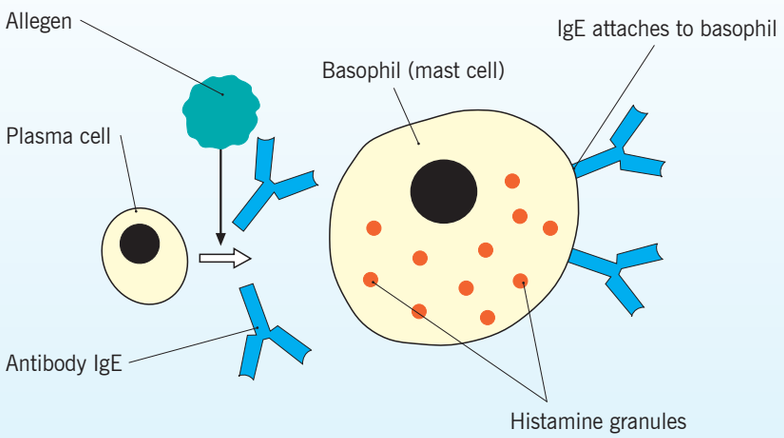
Patients with asthma produce IgEs that bind to the surface receptors of basophils (mast cells) (Figure 3). This binding causes the individual to produce an allergic response, because such an interaction causes basophils to release chemical mediators, such as histamine, serotonin and prostaglandins, against this 'antigenic insult' (Clancy and McVicar 2009). These chemicals are responsible for increasing blood capillary flow (vasodilatation), capillary permeability, smooth muscle contraction in respiratory airways, and the production of respiratory mucus resulting in the symptoms of asthma, such as bronchial hyperreactivity. It is logical to think that because some people are allergic that the tendency to produce IgEs in response to specific allergens may be determined genetically.

The chain of events leading from exposure to allergen to bronchospasm, mucus hypersecretion and bronchial oedema is complex. The first phase of bronchospasm is produced by histamine and parasympathetic nerve activity to the airways. The second phase is a response to released prostaglandins, thromboxanes and leukotrienes, collective examples of eicosanoids, considered to be local chemicals that have a specific effect on target cells and, in the case of asthma, these chemicals play a role in inflammation of the airways (Clancy and McVicar 2009). Consequently, drugs are developed to block these chemicals. For example leukotriene receptor antagonists, such as montelukast, can play a pivotal role in the management of asthma by blocking the leukotriene receptors and reducing inflammation (Clancy and McVicar 2009).

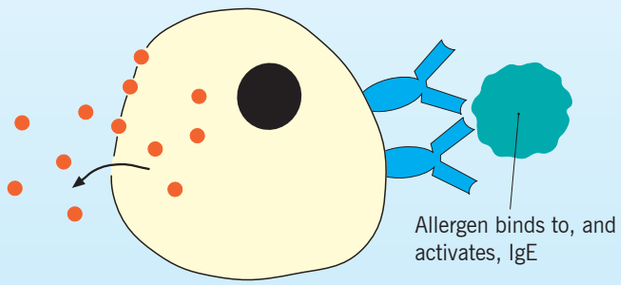
The role of eosinophils (white blood cells) is important when considering inflammatory diseases such as asthma. Eosinophil counts increase during an allergic episode, as a homeodynamic adaptive response; these cells are thought to exert anti-inflammatory effects by absorbing histamine (Clancy and McVicar 2009). According to the BTS asthma guidelines (2012), higher sputum eosinophil counts are associated with more

Figure 3 **Physiological reactions associated with allergic reactions such as asthma**

First exposure to allergens such as house dust mite, mould, pollen or minute scale from animal hair, feathers or skin



Second exposure to allergens



Following IgE activation, the basophils secrete histamine, which leads to inflammation of the membranes of the upper respiratory tract and bronchoconstriction.

(Clancy and McVicar 2009)

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marked airways obstruction, greater asthma severity and atopy. Research has aimed to establish the response of eosinophil counts to inhaled corticosteroids (ICS) (Hodgkin *et al* 2009). Cullinan *et al* (2004) undertook a cohort study of which sputum eosinophilia was seen to decline with the use of ICS in children newly diagnosed with asthma.

There is growing evidence that significant levels of eosinophilic airway inflammation are more closely linked to a positive response to corticosteroids than other measures, even in patients with a diagnosis other than asthma (BTS 2012). In specialist centres the use of sputum eosinophil count to guide corticosteroid therapy has been shown to reduce exacerbations in adult patients with severe disease. This process is not used to aid clinical diagnosis, only for research purposes, but offers possibilities for future practice.

Now that more is known regarding the role of IgE and eosinophils in the inflammation process, more explicit diagnostic testing and monitoring could be considered. Skin tests, monitoring of blood and sputum eosinophils and IgE levels could all play a part in the diagnosis of asthma and atopic illness and, perhaps more importantly, ensure that the individual is treated at the appropriate level therapeutically with minimal side effects. The BTS/SIGN asthma guidelines (2012) recommend a stepwise approach to asthma therapy, whereby treatment is stepped up and down according to the severity of symptoms, the degree of associated lung dysfunction and the tolerance of each patient-specific drug. We believe that this trial-and-error approach can be time consuming and expensive for the patient, and hypothesise that if appropriate treatment could be more specifically predicted by means of further testing, this would offer benefits to the patient and healthcare provider.

Now do time out 4

4 Eosinophil and sputum

Time out

In your patient case study, were eosinophil counts recorded and did this seem to relate to the success or otherwise of any corticosteroid treatments used? Did you discuss with the patient the rationale for sputum or other samples taken and their link to treatments prescribed by the doctor?

Janeway *et al* (2011) recognised that the mainstay of asthma therapy is drugs that treat the symptoms of allergic disease and limit the inflammatory response. These authors speculated that a target for therapeutic intervention might be the high-affinity IgE receptor. An effective alternative, such as humanised anti-IgE monoclonal antibodies for IgE, could prevent the binding of IgE to the surfaces of mast cells, basophils and eosinophils and hence activation of the antibody (Clancy and McVicar 2009).

Now do time out 5

5 Patient history

Time out

Review your case study patient. Did he or she report a history of asthma problems in his or her family background? If so, how did that seem to influence his or her disposition to treatment? Ambivalent attitudes towards treatment may stem from different sources, but did insights into family history seem to affect the patient's attitude towards treatment, either positively or negatively?

Nature-nurture aetiology

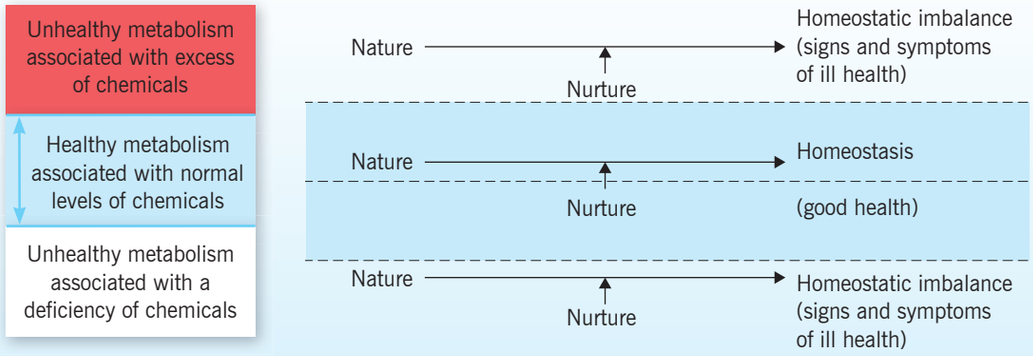
It has long been known that there is a hereditary predisposition in acquiring asthma. According to the National Center for Biotechnology Information (2010), 23 asthma susceptibility genes have been identified on chromosomes 2, 5, 6, 7, 11, 12 and 14, as well as a gene protecting against asthma on chromosome 4. Meanwhile, the Human Genome Project (2013) concludes that more than 250 genes have varying levels of association with the disease, indicating that asthma, like many other diseases, is a polygenically inherited disorder (Clancy and McVicar 2009).

It is generally accepted by geneticists that environmental risk factors trigger the expression of asthma susceptibility disease genes, and this is supported by the work of:

- Van Eerdewegh *et al* (2002), who concluded from their twin and family studies that, although environmental factors play a significant role in the development of asthma, there is also a strong genetic component. The authors claimed that a genome-wide scan of 460 Caucasian families identified that a locus on chromosome 20p13 was linked to asthma. The same study revealed that of the 135 polymorphisms in 23 genes identified, the ADAM33 gene was significantly associated with asthma, where it is thought to play a part in bronchial hyper-responsiveness.
- Cookson *et al* (2004), who stated that the ADAM33 gene is expressed in bronchial and other muscle tissues in the presence of airway inflammation arising from environmental allergic antigenic insults.

Studies involving identical twins reveal that although they have the same chance of developing the disease, often only one twin might present the signs and symptoms of the disease. This could be explained by one twin

Figure 4 **Homeodynamism/health and homeodynamic imbalance/illness – a nature-nurture approach**



Respiratory function of a patient with asthma: normal bronchial activity (blue area) indicates normal level of chemicals associated with normal bronchial activity. NB. Chemical production is a result of nature-nurture interactions.

Increased bronchial activity (red area) caused by an excess of chemical mediators associated with inflammatory processes of asthma. These mediators arise from nature – genetic susceptibility, asthma genes and absence of genetic protective genes against asthma, and nurture – environmental triggers of asthma, such as allergens, respiratory infections, exercise, mould, animal fur, pollen and house dust mites.

(Clancy and McVicar 2009)

not expressing the gene because of a lack of exposure to the environmental risk factor triggers, or even as a result of gene mutation, or one twin receiving a different level of nutrients in utero, which supports the statement made by Barker (2006) that 'foetal nutrient deprivation affects physiological development in utero and thereby susceptibility to chronic conditions as an adult'.

Along with exposure to asthma-related allergens as an environmental trigger for the development of asthma, there are other environmental triggers that cause the expression of the asthma susceptibility genes. This article is limited to discussing gender and hygiene triggers.

Epidemiological studies show a striking difference in asthma prevalence and severity between men and women. According to Kynyk *et al* (2011), these differences seem to follow principal transition points in the reproductive cycle of women. These authors state that the lifetime likelihood of developing asthma is about 10.5 per cent greater in women than in men, the prevalence of the disease in prepubertal boys is higher than in girls, after 18 years of age the prevalence is greater in females and this difference continues to widen with age. These researchers attribute differences in childhood to boys having smaller airways in proportion to lung volumes than girls, and the differences in prevalence later on have been associated with the female sex hormone and obesity.

It has been proposed that for some there may be an opportunity to avoid asthma through early contact with microbes. Overly clean homes were deemed to increase the risk of asthma later. The 'hygiene hypothesis' suggested that early exposure to microbial products, such as endotoxins, would 'switch off' allergic responses, therefore preventing allergic disease such as asthma (Strachan 2000). Martinez (2009) suggested that when individuals with a variant of the CD14 gene are exposed to high levels of endotoxin, it protects them from developing an allergic response, but people with the same variant gene who are exposed to low levels of endotoxin are at higher risk of an allergy. Such appealing and relatively simple hypotheses are, however, probably not helpful.

It is generally accepted in respiratory medicine that asthma and allergy are complex disorders, with both genetic (nature) and environmental (nurture) components determining disease expression (Figure 4). The use of molecular genetics holds great promise for the identification of novel drug targets for the treatment of asthma and allergy. Genome-wide linkage studies have identified a number of potential disease susceptibility loci, but to date replication remains inconsistent (Denham *et al* 2009), so making specific drugs for individual needs may be a long way off.

Now do time out 6

6 Asthma causation

Time out

Identify any personal explanations of asthma causation that your case study patient has used. How did you respond to these and does that matter? Illness explanation may influence how patients self-manage a condition, so what might you need to explain to help motivate them to manage their condition effectively?

Clancy and McVicar (2009) suggested that the external environment interacts with individuals, changing their internal environment. In the case of individuals with asthma susceptibility genes, exposure to environmental triggers will result in the signs and symptoms of asthma being displayed. Primary healthcare practitioners are able to demonstrate homeodynamism in action by preventing or reversing the effects of external triggers on the internal environment.

In doing so, most patients with asthma can be managed in primary care, during times of stable asthma control and exacerbation without requiring hospital admission. Clancy and McVicar (2011b) acknowledged that homeodynamic principles are readily discerned in the stages of any healthcare process, such as the assessment, planning, implementation, evaluation and reassessment care process.

Assessment and diagnosis

'The absence of a gold standard definition means that it is not possible to make clear evidence based recommendations on how to make a diagnosis of asthma' (BTS 2012). Diagnosis is therefore difficult, particularly in those aged under five years in whom lung function tests are neither appropriate nor accurate. In this age group, diagnosis may only be based on the presence of symptoms, an accurate clinical history and, where appropriate, a trial of treatment such as a short-acting beta agonist and, if necessary, an inhaled corticosteroid.

To evaluate the effectiveness of a treatment it should later be withdrawn under close supervision to detect any recurring symptoms; this action is to establish that the therapy itself is responsible for the relief of symptoms and not coincidence. While considering the diagnosis of asthma it is essential that acknowledgement is given to the number of differential diagnoses that may present with similar symptoms (BTS 2012).

As with children, the diagnosis of adults also requires a thorough clinical examination and history taking. The gold standard lung function test is spirometry. This test assesses the presence and severity of airflow obstruction and of airway reversibility by performing the tests pre- and post-bronchodilation. Spirometry is preferable to measurement of peak flow because it allows clearer identification of airflow obstruction and the results are less dependent on effort (BTS 2012).

It is the role of the primary healthcare practitioner to detect and assess change just like the receptors of the body's homeodynamic control mechanism. This process could include detecting and assessing symptoms, clinical history, including family history and the presence of other atopic conditions, and performing appropriate lung function tests so that an appropriate diagnosis, treatment and management plan can be established.

Planning and implementation

Once an asthma diagnosis has been confirmed, all patients should be given adequate education about their condition and treatment as well as a tailored asthma management plan. 'Written personalised action plans as part of self-management education have been shown to improve health outcomes for people with asthma' (BTS 2012). This type of plan is aimed at removing the signs and symptoms, that is the homeodynamic imbalances of the respiratory malfunction.

Planning should meet the patient's needs because triggers of symptoms, symptom severity, and threshold for exacerbation and treatment required to restore homeodynamic control will vary enormously. Treatment should be 'stepped up and down' by the clinician, or the patient in accordance with the plan and in conjunction with the BTS/SIGN (2012) guidelines stepwise approach. This process involves the introduction or discontinuation of inhaled corticosteroids, long-acting beta agonists and leukotriene-receptor antagonists as required.

Now do time out 7

7 Homeodynamics

Time out

Revisit your case study patient for a final time and identify how you helped him or her to manage his or her asthma. Why is it important to talk about homeodynamics, the ways in which the body reacts to changing triggers and how an accumulation of problems can develop that challenges maintenance treatment used by the patient? Were there any simplistic beliefs that needed to be countered?

Management plans should be tailored to meet the psychosocial needs of the patient. For example, it may be appropriate for patients with a good understanding of their asthma control, symptoms and normal peak flow to be given a standby supply of oral steroids to start promptly at the time of exacerbation, with the understanding that they will also require follow up with an appropriate clinician. This scenario would not be appropriate, however, in patients with a poor understanding of their condition, for example a patient with dementia or a newly diagnosed child whose parents were not yet knowledgeable enough with regard to symptoms and when stepping up treatment would be appropriate.

Evaluation and reassessment

Measuring the effectiveness of care by an appropriate healthcare professional is equivalent to the feedback processes involved in sustaining homeodynamism. Once treatment and a management plan have been established it is vital to review the patient to

assess the effectiveness of the prescribed therapy, increase medication if the patient remains symptomatic and assess the patient's understanding of his or her condition, treatment and management plan, as well as ensuring that the patient is aware of when to seek medical help.

After initial diagnosis, these reviews may be frequent until the healthcare professional has maintained a homeodynamic balance by keeping the patient symptom free on minimal therapy, and until the clinician and patient are confident that the patient is able to self-manage is or her condition and recognise when his or her asthma is not controlled. At this stage 'asthma is best managed in primary care by routine clinical review on at least an annual basis' (BTS 2012).

Conclusion

Asthma is a cellular (basophils), hence chemical (IgE), homeodynamic imbalance. Overall, the risk, age of onset and severity are influenced by numerous genetically susceptible biological pathways that arise because of exposure to environmental risk factor triggers associated with the disease.

Although there remains a lot to be discovered regarding asthma and its origins, the information gained from the Human Genome Project (2013) has provided, and no doubt will continue to provide, a greater understanding of the disease. This knowledge acquired to date has given primary healthcare practitioners the ability to diagnose, treat and manage the condition throughout its chronic and acute stages, and only a further understanding of the nature-nurture interactions associated with asthma in the future will enable the identification of genes to determine risk for specific patients.

Drug therapy for asthma is often 'trial and error'. Hopefully, however, discoveries from the human genomic and proteonomic projects, such as identifying specific genes and enzymes associated with susceptibility genes for asthma, will help to develop an individualised illness profile. This personalised profile will enable the most appropriate combination of asthma medications to be used, thereby benefiting the primary healthcare practitioner and patient to gain faster, better control of the symptoms with minimal side effects and at a lower cost to the patient and health service.

Now do time out 8

Time out 8 Practice profile

Now that you have finished the article you might like to write a practice profile of between 750 and 1,000 words. Go to the Primary Health Care website, at www.primaryhealthcare.net, and follow the link to the Learning Zone for information on how to make a submission.

Further reading

There is more information on the nature-nurture perspectives and role of healthcare practitioner in:

- Clancy J, Hasthorpe H (2011) Rheumatoid arthritis: a homeodynamic imbalance. *Primary Health Care*. 21, 9, 31-39.
- Clancy J, Newell V (2011) Diabetes and obesity: perspectives of the nature/nurture debate. *Primary Health Care*. 21, 3, 31-38.

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