

Marek Tomaszewski^{1,4}, Grażyna Olchowik^{2,4}, Monika Tomaszewska³

¹Department of Human Anatomy, Medical University of Lublin

¹Katedra i Zakład Anatomii Prawidłowej Człowieka UM w Lublinie

²Department of Biophysics, Medical University of Lublin

²Zakład Biofizyki UM w Lublinie

³I Department of Radiology, Medical University of Lublin

³I Zakład Radiologii Lekarskiej UM w Lublinie

⁴John Paul II State School of Higher Education in Biała Podlaska

⁴Państwowa Szkoła Wyższa im. Papieża Jana Pawła II w Białej Podlaskiej, Instytut Zdrowia

Asthma-consciousness disorders and disease progression

Astma oskrzelowa- świadomość schorzenia, a postęp choroby

Summary

Asthma is one of the most common childhood respiratory diseases in Poland and includes from 5 to 10% of the population. In the world it occurs in varying degrees, depending on the place of several to several tens of percent. In some Member States, two or even three-fold increase in the incidence of asthma in recent decades. There is no scientific evidence to date of a link between an increased incidence of disease and the territory of any specific geographical or biological parameters. From the point of view of hygiene theory, the incidence of severe asthma is combined with the so-called. Western lifestyle, which consists of specific measures to comfort, living conditions and habits of the dominant non-natural, chemical treatments, cosmetic preservatives. An important factor affecting the frequency of cases is the degree of exposure to allergenic and infectious agents. At the root of asthma lies the allergic-immunologic mechanisms and intern tendency to react to certain substances of human external environment. This article contains the current state of knowledge about the nature of the disease and forms of coping with the disease.

Keywords: asthma, bronchial hyperresponsiveness, bronchial obstruction

Streszczenie

Astma oskrzelowa jest jedną z częstszych dziecięcych chorób układu oddechowego w Polsce i dotyczy od 5 do 10% populacji. Na świecie występuje ona w różnym nasileniu, w zależności od miejsca, w kilku procentach do kilkudziesięciu. W niektórych państwach odnotowuje się jednak dwu a nawet trzykrotny wzrost zachorowalności na astmę w ciągu ostatnich dziesięcioleci. Nie ma do dzisiaj naukowych dowodów na związek między wzmożonym występowaniem choroby a terytorium o jakichkolwiek określonych parametrach geograficznych czy biologicznych. Z punktu widzenia teorii higienicznych nasilona zachorowalność na astmę oskrzelową łączy się z tzw. zachodnim stylem życia, na który składają się specyficzne, zmierzające do komfortu, warunki mieszkaniowe i żywieniowe z dominantą nienaturalnych, chemicznych środków pielęgnacyjnych, kosmetycznych, konserwujących. Istotnym uwarunkowaniem częstotliwości zachorowań jest też stopień ekspozycji na czynniki alergizujące oraz infekcyjne. U podłoża astmy oskrzelowej leżą więc mechanizmy

alergiczo-immunologiczne oraz wrodzona skłonność do reakcji na niektóre substancje środowiska zewnętrznego człowieka. Poniższy artykuł zawiera aktualny stan wiedzy na temat istoty choroby oraz formy radzenia sobie z tą chorobą.

Słowa kluczowe: astma oskrzelowa, nadreaktywność oskrzeli, obturacja oskrzeli

Introduction

Asthma is a chronic respiratory disease involving many body cells which release substances that contribute to its development. It is characterized by increased airway hyperresponsiveness that leads to recurrent episodes of wheezing, dyspnea, chest tightness, and persistent cough. Symptoms usually occur at night and in the morning. The clinical picture is usually accompanied by diffuse bronchial obstruction, which is reversible either spontaneously or with treatment (GINA, 2010).

Bronchial asthma can be divided according to the etiology of the allergic and non-allergic, due to the severity and course of the sporadic and chronic (mild, moderate and severe), or because the degree of control of the disease in a controlled, partly controlled and uncontrolled (Fanta, 2009; British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009).

Asthma is one of the most common chronic diseases of the respiratory system, where the prevalence is estimated at an average of approximately 5% in adults, women often suffer. The average annual death rate for this reason, is about 180 000 worldwide. The disease course is often episodic, with a tendency to remission (Fanta, 2009; British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009).

According to current standards of asthma diagnosis is possible only after three years of life (3-5 years). At this time the attacks of asthma occur without associated viral infections, and the results indicate auxiliary usually allergic etiology. In younger children (<3 years) diagnosis and treatment of this disease is difficult because of the lack of effective methods for monitoring bronchial obstruction, a different course than in older children and not fully understood pathophysiology. Asthma is diagnosed in adulthood is often non-allergic and has a more severe (Global strategy for the Diagnosis and Treatment of Asthma in Children 5 Years and Younger, 2009; Papadopoulos, 2012).

Pathomechanism of asthma

Asthma is a chronic inflammatory disease of the lower respiratory tract, wherein the air restriction is caused by swelling of the bronchial mucosa (inflammation), bronchial smooth muscle contraction (bronchial hyperreactivity, and obstruction), the formation of mucus plugs and bronchial remodeling (Brown et al. , 2006).

The inflammation of the bronchi leading to asthma, formed under the influence of various triggers: physical (cold air, increased humidity, dust, dirt, soot, odors), biological (plant food allergens, viruses, bacteria, fungi, parasites, feathers) chemicals (ozone, brick, cement, foodstuffs), individual differences (physical, individual predispositions). These factors cause the activation of the cells (mast cells, eosinophils, T lymphocytes) that produce various inflammatory mediators, chemokines, cytokines and growth factors (GINA, 2010).

In the case of allergic asthma underlying disease is IgE-dependent mechanism. This applies especially to children and young adults. In this group of patients in contact with an allergen leads to the early phase of an allergic reaction, initiated by the binding of allergen-specific IgE antibodies on the surface of mast cells. The granularity of the cells reaches to the release of inflammatory mediators including histamine, proteases and heparin. In addition, new products such as cysteinyl leukotrienes, prostaglandins D2 and adenosine. In consequence, there is initiated state bronchial obstruction. After 6-8 hours, discloses a late phase of an allergic reaction. At this time, mast cells, basophils, and other cells release cytokines and chemokines, multiply bronchial influx of inflammatory cells (especially eosinophils). At the same time as the resulting state, comes to tilt the balance in the direction of CD4 + Th phenotype. Th cells secrete include: IL-4, IL-5, IL-9, IL-13 (Fanta, 2009, Sutherland et al., 2004).

Pathophysiology non-allergic asthma is not fully understood. Perhaps at the root of this state shall be immune process, triggered by an infection. However, histology of allergic and non-allergic asthma is very close. The cells of the airway wall (fibroblasts, myofibroblasts, smooth muscle cells) secrete several cytokines and growth factors, contributing to keep a chronic inflammatory bronchial epithelium. Damaged epithelium stimulates repair processes, resulting in structural and functional changes, present even in the early stages of the disease (bronchial reconstruction). It leads to fibrosis reticular layer of the basement membrane hypertrophy of fibroblasts and smooth muscle cells, hypertrophy of mucous glands, and bronchial epithelial goblet cells and increased vascular proliferation. These changes make for a particularly severe cases, obstruction is irreversible (Fanta, 2009, Sutherland et al., 2004).

Risk Factors

The main risk factors for asthma can be divided into:-individual and environmental factors. The individual factors include: genetic predisposition, allergies, bronchial hyperresponsiveness, female sex, and black race. Environmental factors affecting the development of asthma in predisposed individuals include indoor allergens (house dust mites, pet allergens, molds and yeast), the external environment allergens (pollen), occupational factors for skin sensitization, tobacco smoke (smoking active and passive), air pollution and indoor respiratory infections, parasitic infestations, socio-economic status and obesity. (GINA, 2010, Fanta, 2009, Sutherland et al., 2004).

The factors that trigger asthma attacks and exacerbations or bring their persistence include indoor allergens atmospheric and indoor air pollution and indoor respiratory infections, exercise and hyperventilation, changes in the weather, food and / or food additives drugs (beta-blockers, aspirin), very strong emotions, tobacco smoke, irritants (aerosols used in household paint fumes) (Fanta, 2009, Sutherland et al., 2004).

The clinical picture

During the seizure shortness of breath and no exacerbations of asthma, signs and symptoms may be absent. Exacerbation of asthma can be mild, moderate or severe. Many years of untreated or poorly treated disease eventually leads to progressive, irreversible airflow limitation by inhalation and can lead to death of the patient (Fanta, 2009; GINA 2010).

The symptoms include: shortness of breath exhaust (paroxysmal, variably severe, can occur at any time of the day or night after exposure to a trigger and resolve spontaneously or

with treatment) or chest tightness, wheezing, cough (dry, paroxysmal) and other symptoms of allergic diseases (eg, allergic rhinitis) (Fanta, 2009; GINA 2010).

Among the signs of lung fields be heard wheezing (diffuse, bilateral, exhaust) or dry rale and observed prolonged exhalation. When it comes to the severity of dyspnea is labor intensive accessory muscles and tachycardia (Fanta, 2009; GINA 2010).

In asthma exacerbations occur, which can have a different waveform. When tightening up gradually (hours, days, weeks) is the most common cause of respiratory infection or failure of prior therapy. Treatment of this condition is also done slowly. In the case of exacerbations the symptoms develop rapidly (asthma attack), they are mainly caused by an allergic reaction to a trigger. In this case, the response to treatment is generally faster (Fanta, 2009; GINA 2010).

Recognition

Among the disease entities with dyspnoea, to differentiate from asthma are mentioned: COPD, vocal dysfunction, heart failure, bronchiectasis, pulmonary embolism, respiratory tract infections and other less common, such as tumor or a foreign body in the airway, tracheal stenosis after tracheostomy, bronchiolitis obliterans or pneumothorax (Fanta, 2009; GINA 2010).

If symptoms such as recurrent wheezing in the chest, coughing and / or shortness of breath occurring especially at night and in the morning, when changes in humidity, temperature, air inhaled or during exercise, you can also consider the possibility of a diagnosis of asthma (GINA 2010).

The diagnosis of asthma is based on: a typical interview, the signs in question (if present), the presence of reversible airflow obstruction, bronchial hyperresponsiveness finding in cases without obstruction on spirometry and reduced peak expiratory flow (PEF) or increased diurnal variation in PEF (GINA, 2010).

Interview is one of the most important methods of confirming asthma. It allows you to build a picture of the disease, based on the data obtained in the past. If the information of mentions a persistent inflammation of the bronchi and lungs, respiratory infectious diseases, acute upper respiratory tract infections, persist after treatment with antibiotics, family prone to allergic reactions, and completed the child is allergic disease, it may be suspected asthma. The existence of environmental factors (concomitant diseases, air quality) affects the frequency of asthma attacks, as well as increasing the frequency of contacts with various allergens. The region is typified variability of symptoms, such as reducing the dose of drugs, spontaneous remission or exacerbation. Their frequency increases, however, with the duration of the disease (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009).

An indication of the existence of asthma in the course of a prolonged hardened exhaust phase, combined with diffuse wheezing on lung fields and reinvent the symptoms of shortness of breath. None of these symptoms do not preclude the disease because the patient may be at the time of disease remission (Brown et al. 2006).

Setting inspiratory chest between the attacks of dyspnea indicates an obstruction phase of distension of the pulmonary parenchyma-it is sometimes the only symptom of the disease. The state of the patient's airway hyperresponsiveness in asthma as a

symptom may indicate the occurrence gradually worsening cough, wheezing during the test or exercise any hyperventilation [Brown et al., 2006; Sutherland et al., 2004].

The physically diagnosed allergic diseases, asthma is often associated are: team atopic dermatitis, allergic rhinitis or conjunctivitis (Brown et al., 2006; Sutherland et al., 2004; Fanta, 2009).

On the basis of physical examination, based on clinical and functional asthma was established and characterized the degrees of gravity.

The criteria indicating the degree of severity was found: the frequency of daytime and night-time symptoms between attacks of breathlessness, and rate of FEV1 (forced expiratory volume in one second) and PEF (peak expiratory flow). In the current percentage w / w ratios are compared to predicted or maximum value for the patient. The percentage of variability due to the difference of the evening and morning. There are four degrees of severity of asthma (GINA 2010):

- Stage 1, which is characterized by intermittent asthma less frequent than once a week, the daily occurrence of symptoms between episodes, and less or equal to two times a month nocturnal symptoms. FEV is less than or equal to 80% of the value, a variation less than 20%.
- Stage 2, mild chronic asthma has more or equal to one time per week daytime symptoms, night more than two times a month. FEV as above, and the variation between 20 and 30%.
- Stage 3, moderate persistent asthma, a daily daytime symptoms, night once a week, FEV more than 60 to 80% of predicted, and the variability of more than 30%. In this case, the attacks of angina disrupt life activity.
- Stage 4, severe persistent asthma, daytime symptoms on a daily basis, night-often, FEV less than 60% of the value and volatility greater than 30%. Symptoms restrict daily life activity.

Because of the degree of control of the disease, bronchial asthma can be divided into (GINA 2010):

- Asthma is controlled where daytime symptoms occur more often than two times a week there is no limit daily activities, nocturnal symptoms and exacerbations, emergency treatment is required more often than two times a week PEF or FEV1 fall within the normal range
- Asthma is partly controlled where daytime symptoms occur more frequently than 2 times per week, with minor limitations, daily activities and night symptoms, emergency treatment is required more often than two times a week PEF or FEV1 values are <80% of predicted or maximum patient, exacerbations occur more frequently than once a year
- Uncontrolled asthma observed in at least three partially controlled asthma criteria met in any one week, with at least one exacerbation in any one week (every week with exacerbation of asthma is considered to be a week from uncontrolled asthma).

The diagnosis of asthma is the differential diagnosis, a complete list of the symptoms of the disease to others, such as immunocompromised groups, airway inflammation and sinusitis, aspiration groups, including foreign body aspiration, cystic fibrosis,

pulmonary embolism, bronchopulmonary dysplasia disorders, construction and function of the respiratory system (pneumothorax tracheomalacia, bronchiectasis, bronchiolitis obliterans, vascular compression, fistula between the respiratory and digestive tract, tumors of the chest, the teams ciliary dyskinesia, stenosis of the larynx, paralysis, paresis, vocal cord dysfunction, narrowing trachea after tracheotomy), defects in the cardiovascular system, heart failure, abnormal emotional and neurotic (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009).

The diagnosis of asthma beside basic physical examination performed additional tests, using measuring devices. These include spirometry, measurement of PEF a peak flow meter, test the reversibility of airflow obstruction, airway hyperresponsiveness test. Pulsoximetry and arterial blood gas analysis is performed to assess the severity and monitoring of exacerbations (GINA, 2010).

Spirometry is a lung volumes during forced expiration, performed by the spirometer. It can be given to persons who have completed 7-8 years of age and are able to repeat spirometry testing. The presence of asthma in one of its symptoms, airflow obstruction, indicating lower rates of FEV1 and PEF less than 80% predicted. The continuing process of obstruction also causes a decrease in the FVC, or forced vital capacity. The study spirometry calculated rate of lung volume and bronchial patency rates (Szczeklik and Gajewski, 2011).

- Indicators spirometric lungvolume:
 - VC vital capacity (quiet exhaust)
 - FEVC - Forced vital capacity exhaust(of less than 6arenot suitable for interpretation; in chronic obstructive pulmonary disease FVC is less than VC)
 - FIVC - Forced inspiratory vital capacity
- Indicators spirometric bronchial obstruction:
 - FEV1 - severe expiratory volume in one second (the “gold standard”)
 - FEV1/VC - rate Tiffeneau
 - MEF50-the maximum flowafter50% of severe exhaust (test small airways)
 - PEF - peak expiratory flow (test less reliable than FEV1).

PEF measurements using the peak flow meter (peakflowmetry) is used in asthma control that you can do at home, although not as accurate as spirometry. If the device shows the PEF less than 60% predicted or maximum for the patient as soon as possible to intervene therapeutically as measurement points to inadequate control of the disease. With the score 60-80% range of control is sufficient, but it requires the verification of treatment. PEF ratio above 80% indicates good control of the disease (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009, GINA, 2010).

Bronchial obstruction reversibility test check determines whether bronchial obstruction improved after inhalation of a short-acting alpha-2-agonist. Repeated after 15-20 minutes then measuring FEV1 or PEF. The observed relative increase in FEV1 of 12% compared to baseline or above 15% PEF is the basis for the diagnosis of asthma (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009, GINA, 2010).

During dyspnea asthmatic attack is carried out arterial blood gases. It allows the evaluation of the degree of disorder of ventilation and hypoxemia. PaO₂ less than 60 mmHg and PaCO₂ greater than 45 mmHg while breathing air show a very severe exacerbation of asthma and the need for immediate oxygen administration and implementation of hospital treatment in the ICU (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009, GINA, 2010).

Another additional test is a test of airway hyperresponsiveness performed by comparing measurements of FEV₁ before and after inhalation of incrementing doses or concentrations of the factors that cause bronchospasm, usually histamine or methacholine. These data are used to calculate the value of PD₂₀ or PC₂₀, the dose or concentration of a substance which causes a reduction in FEV₁ of 20%. The lower the values, the sensitivity of the bronchi is greater. However, test accuracy is not characterized as only negative values allow the exclusion of asthma, while positive is not always confirm the diagnosis (British Guideline on the Management of Asthma. May 2008, revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009, GINA, 2010).

Perform additional testing in the form of positive allergy tests is not the diagnosis of asthma. They help only to detect risk factors for the development of the disease, thus sensitizing allergens, which can be at least partially eliminated from the patient's environment (GINA, 2010).

The most frequently used tests to detect allergies immediate (Type I), IgE-mediated, and late (type IV), which confirms the presence in the skin of immunoglobulin E (IgE), which reflect a genetically determined immune blemish-atopy. Detection of Type I allergy skin prick tests are used, and under the skin, and type IV allergy help diagnose epidermal patch test. The diagnosis of allergic (atopic) are important prick tests skin (PTS) (GINA, 2010, Fanta, 2009).

PTS is designed to confirm the presence of specific IgE in the skin by inducing immediate erythematous reaction was purged as a response to a given allergen. Skin response is associated with mast cell degranulation and release of mediators of the early allergic response, especially histamine. The allergens used in testing PTS include statements inhalants (pollens of grasses, trees and grains, mold spores, animal dander, dust mites) and food over the latex and insect stings (GINA, 2010, Fanta, 2009).

PTS is easy to make, safe, very kind, allergenic extracts have a long service life. In contrast, intradermal test rarely discloses the reaction of late (GINA, 2010, Fanta, 2009).

Before performing the PTS should be discontinued drugs that inhibit skin reaction (glucocorticoids, medications p / histamine). Then carried out two controlled trials (test must fall negatively) with solvent antigen and histamine test, assessment of skin reactivity. Keep in mind that children, including those with atopic dermatitis and metastatic malignancies, can be seen less skin reactivity (GINA, 2010, Fanta, 2009).

It is important to care about the quality of the preparation of allergen and the need to store them at 2-8° C (lyophilized especially insects Hymenoptera venom allergens and allergen solutions stabilized glycerol or albumin). According to medical prescription only dry skin intact and suitable for performance testing. Even healed lesions are a contraindication, because damaged nerve endings of the skin give false negative reactions. Positive Control allows you to determine the correct skin reactivity and

technology studies, and excludes the existence of negative adverse reactions to trauma (eg too strong prick), solvent or used equipment. The prick tests can be used Polfa histamine dihydrochloride solution (1: 1000, in an ampoule) (GINA, 2010, Fanta, 2009).

Histamine produces an average bubble diameter (the largest and perpendicular to it passing through its center) of at least 3 mm, and this reaction is always accompanied by erythema (GINA, 2010, Fanta, 2009).

Skin prick tests performed on the volar aspect of the forearm. Allergenic extracts is applied in a distance of 5 cm from the wrist and at least 3 cm from the elbow, which is associated with a lower reactivity of the skin around the wrist (GINA, 2010, Fanta, 2009).

Histamine, like allergens strong reaction should be applied closer to the cubital fossa, and those with fewer assays - closer to the wrist. Such positioning includes lymph flow toward the heart. Special lancet puncture the skin (non-rechargeable), and assuming a drop of the solution, it should go through the superficial layer at an angle of 60-70 degrees (it should be slightly lifted and create a small canal). The second way, accompanied by a gentle, one-second compressions, the puncture perpendicular to the surface of the skin. The appearance of bleeding disqualifies the study. Never use tests from the fridge. Too low temperature of the solution may cause a contraction of the skin and a decrease in acidity. Tests are read after 15 to 30 minutes, depending on the patient (GINA, 2010; Fanta 2009; Szczeklik and Gajewski, 2011).

Treatment

Asthma is a chronic disease that “modern medicine” cannot be cured, but proper drug treatment generally allows you to control the disease. The general recommendation is effective therapy: proper inhalation technique of inhalation drugs, a written self-management plan for the patient, for the treatment of chronic and steps the patient should be taken in the event of exacerbations, avoidance of exposure to the patient triggers seizures and exacerbation of asthma and influenza vaccination (Szczeklik and Gajewski, 2011).

Among the drugs used in the treatment of asthma controller medications include disease (taken daily) and relievers (assumed temporarily). The first group include: corticosteroids (CS) is inhaled (beclomethasone, budesonide, ciclesonide, fluticasone), oral corticosteroids (prednisone, prednisolone, methylprednisolone), long-acting beta-2 agonists (formoterol, salmeterol), leukotriene (montelukast, zafirlucast), methylxanthines in sustained release form and omalizumab (monoclonal anti-IgE used in the severe and very poorly controlled allergic asthma). The second group includes: fast-acting beta-2 agonists (fenoterol, salbutamol), a short-acting inhaled anticholinergics (ipratropium bromide) as well as oral corticosteroids and other drugs for a short time, in order to control asthma exacerbations. Choice of drugs depends on the degree of asthma control and current treatment (Szczeklik and Gajewski, 2011).

Conclusion

Asthma is a chronic inflammatory disease of the lower respiratory tract symptoms like wheezing and persistent cough. Over time uncontrolled disease results in rebuilding the walls of the bronchial tree, leading to a reduction in physical activity and life. Following the general principles for the prevention of asthma exacerbations may be

greater or lesser extent (depending on the patient's subordination) to control the disease. Suitable conditions will not halt the awareness of the disease, but it can reduce the inevitable progress.

Bibliography

1. Szczeklik A., Gajewski P. (2011). Choroby wewnętrzne. Medycyna Praktyczna
2. Global Strategy for Asthma Management and Prevention, Global Initiative for Asthma (GINA) (Update 2010). <http://www.ginasthma.org> (cyt. 24.10.2012)
3. Global Strategy for the Diagnosis and Treatment of Asthma in Children 5 Years and Younger (2009). <http://www.ginaasthma.org> (cyt. 28.10.2012)
4. British Guideline on the Management of Asthma. (May 2008), revised June 2009. British Thoracic Society, Scottish Intercollegiate Guidelines Network. 2009. Available at: <http://www.sign.sc.uk/guidelines/fulltext/101/index.html>. Accessed April 8, 2010
5. Papadopoulos N.G., Arakawa H., Carlsen K-H et al. (2012). International consensus on (icon) pediatrics asthma. *Allergy*. 67, 976-997
6. Fanta C.H. (2009). Asthma. *N Engl J Med*. 360, 1002-1014
7. Sutherland E.R., Martin R.J., Bowler R.P., Zhang Y., Rex M.D., Kraft M. (2004). Physiologic correlates of distal lung inflammation in asthma. *J Allergy Clin Immunol*. 113, 1046-1050
8. Brown R.H., Pearse D.B., Pyrgos G., Liu M.C., Togias A., Permutt S. (2006). The structural basis of Airways hyperresponsiveness in asthma. *J Appl Physiol*. 101, 30-39

Number of signs with spaces: 28 018