CASE FOUR

Short case number: 3_20_4
Category: Children & Young People / Respiratory & ENT Systems
Discipline: Paediatrics Medicine
Setting: General Practice
Topic: Asthma - acute exacerbation

Case
Adrian Neasby, is a 12 year old asthmatic who is well known to you, he presents with cough and wheeze. Adrian has had an upper respiratory tract infection for a few days. Today while playing soccer he found it hard to get his breath and he couldn't finish the game. **He regularly uses Flixotide [fluticasone] inhaler 200ug per day. Normally his asthma is well controlled.** **Observation: no acute respiratory distress.** **PEFR = 230 l/min [normal best is 340 l/min]** **Height 149 cm**

Questions
1. Describe the key clinical, physiological, pathological and immunological features of asthma. 2. What key questions would you ask to assess how well controlled Adrian's asthma is? 3. What clinical parameters [history, examination and investigations] would you assess in order to classify the severity of Adrian's asthma? Present these parameters in a table indicating the features of mild, moderate & severe asthma. 4. Adrian's mother mentions that quite a number of children on his soccer team have asthma, she asks you what causes asthma, how would you explain this to her? 5. Adrian's mother mentions that Adrian recently had spirometry performed that showed he had asthma. What are the diagnostic features of asthma on spirometry? 6. You explain to Adrian and his mother the different medications used in asthma and how they work, summarise in a table the indications, contraindications and side effects of the following medications; beta-2 sympathomimetics, sodium chromoglycate, leukotriene antagonists, inhaled and oral corticosteroids, ipratropium bromide, Magnesium, theophyllines and long acting beta agonists. 7. Develop an asthma management plan for Adrian that outlines the acute and ongoing management, as well as the plan for future exacerbations.

Suggested reading:

- South M, Isaacs D editors. Practical Paediatrics. 7th edition. Edinburgh: Churchill Livingstone; 2012.
- Thomson K, Tey D, Marks M, editors. Paediatric Handbook. Staff of the Royal Children's Hospital Melbourne, Australia. 8th edition. Chichester: Wiley-Blackwell; 2009.
- Australian Asthma Handbook (https://www.asthmahandbook.org.au/) last accessed 9 Jan 17

ANSWERS

1. Describe the key clinical, physiological, pathological and immunological features of asthma.

CLINICAL: asthma is recurrent episodes of wheeze, cough and breathlessness. This is an oversimplification, because it is possible to have asthma without the triad of wheeze, cough and breathlessness. Furthermore, a minority of children with these symptoms will have other conditions.

PHYSIOLOGICAL: asthma is a condition associated with airway hyper reactivity and with reversible airways obstruction.

Objective measurement of airway hyper responsiveness can be obtained by measuring lung function such as peak expiratory flow (PEF) or forced expiratory volume in 1 second (FEV_1) in a bronchial challenge test. Airway hyper reactivity is defined as a significant fall (usually about 15-20%) in lung function after inhalation of chemicals (such as methacholine, histamine or mannitol), after inhalation of hypertonic saline, after cold, dry air or following exercise.

Airway hyper reactivity and reversible (or variable) airways obstruction also may be demonstrated by an increase in PEF or FEV_1 of more than 10% following a bronchodilator, or by fluctuations in PEF measurements obtained on a regular basis at home.

There are limitations to this physiological definition of asthma. These include the fact that most children are unable to cooperate with challenge tests to measure airway hyper responsiveness (AHR) until they are 5 or 6 years old, and that there is an imperfect correlation between children with AHR and clinical features of asthma.

PATHOLOGICAL: asthma relates to mucosal oedema, mucous hypersecretion and smooth muscle spasm in the small airways. Airway inflammation is prominent.

IMMUNOLOGICAL: asthma is on the atopic state. In an allergic response, degranulation of mast cells occurs, with the release of chemical mediators into the airways and a resultant asthmatic response. Our understanding of the cytokines that are important in asthma remains incomplete. Indeed, the mast cell, the eosinophil and the neutrophil all seem to have important roles in the pathogenesis of asthma.

2. **What key questions would you ask to assess how well controlled Adrian's asthma is?**

The diagnosis of asthma (and ongoing symptoms in uncontrolled asthma) can be made make in the child who has:

- recurrent episodes of wheeze
- breathlessness
- cough

And who is

- completely well between attacks.

Other clinical presentations may be:

- nocturnal cough
- persistent cough in association with acute respiratory infections
- a history of 'rattly breathing' in the absence of a definite history of wheeze.

3. What clinical parameters [history, examination and investigations] would you assess in order to classify the severity of Adrian's asthma? Present these parameters in a table indicating the features of mild, moderate & severe asthma.

Asthma management handbook:

Table 2. **Classification of asthma in children over 5 years old**

	Daytime symptoms between exacerbations	Night-time symptoms between exacerbations	Exacerbations	PEF or FEV_1*	PEF variability**
Infrequent intermittent	Nil	Nil	Brief Mild Occur less than every 4–6 weeks	More than 80% predicted	Less than 20%
Frequent intermittent	Nil	Nil	More than 2 per month	At least 80% predicted	Less than 20%
Mild persistent	More than once per week but not every day	More than twice per month but not every week	May affect activity and sleep	At least 80% predicted	20–30%
Moderate persistent	Daily	More than once per week	At least twice per week Restricts activity or affects sleep	60–80% predicted	More than 30%
Severe persistent	Continual	Frequent	Frequent Restricts activity	60% predicted or less	More than 30%

Adapted from GINA 2005[6]

An individual's asthma pattern (infrequent intermittent, frequent intermittent, mild persistent, moderate persistent or severe persistent) is determined by the level in the table that corresponds to the **most severe** feature present. Other features associated with that pattern need not be present.

* Predicted values are based on age, sex and height

** Difference between morning and evening values

FEV_1: Forced expiratory volume in 1 second; PEF: peak expiratory flow .

Assessment of the severity of an attack:

The severity of acute asthma can be classified as mild, moderate, severe or critical. The most reliable indicators are mental state and work of breathing (comprising accessory muscle use and recession).

Patients with an acute exacerbation of asthma requiring salbutamol every 3 h at home should be assessed by their Local Medical Officer or in the emergency department.

- The initial arterial O2 saturation (SaO2) in air, heart rate and ability to talk should be used as additional features in assessing the severity of acute asthma.
- Wheeze intensity, central cyanosis, pulsus paradoxus, peak expiratory flow are not reliable or the assessment of the severity of acute asthma.
- Arterial blood gases, CXR and spirometry should not be routinely used in assessing the severity of acute asthma.

Assessment of the severity of an acute asthma attack

Sign	Mild	Moderate	Severe	Critical
Mental state	Normal	Normal	Agitated	Confused/drowsy
Work of breathing	Normal	Mildly increased	Moderately/markedly increased	Maximally increased or exhausted

4. **Adrian's mother mentions that quite a number of children on his soccer team have asthma, she asks you what causes asthma, how would you explain this to her?**

Causes of asthma:

Predisposing

- Genetic: ?chromosomes 5, 6, 7, 11, 12

Inducers (sensitisers)

- Hygiene hypothesis
- Allergens
- Cigarette smoke
- Other irritants, such as ozone
- Occupational (rare in children)

Triggers

- Infections, e.g. viral, *Mycoplasma*, pertussis
- Exercise, especially in cold, dry air
- Allergens, e.g. house dust mite, pollen, animal dander, foods
- Environment, e.g. cigarette smoke, ozone, SO_2
- Emotional, such as laughing
- Chemicals, e.g. salicylates, metabisulphite

Sustainers (maintainers)

- Allergens
- Viruses
- Environmental irritants

5. **Adrian's mother mentions that Adrian recently had spirometry performed that showed he had asthma. What are the diagnostic features of asthma on spirometry?**

Spirometry to measure FEV_1 and forced vital capacity before and after a bronchodilator may help assess severity and response to therapy. Between exacerbations, children with intermittent disease will have normal lung function and no further improvement after bronchodilators. Children with persistent symptoms may show airways obstruction with improvement after inhalation of a bronchodilator. Fixed airways obstruction suggests either severe asthma or an alternative diagnosis such as cystic fibrosis.

6. **You explain to Adrian and his mother the different medications used in asthma and how they work, summarise in a table the indications, contraindications and side effects of the following medications; beta-2 sympathomimetics, sodium chromoglycate, leukotriene antagonists, inhaled and oral corticosteroids, Magnesium, ipratropium bromide, theophyllines and long acting beta agonists.**

Medication	Indications	Contraindications / Precautions	Side effects
Beta-2 sympathomimetics <u>Salbutamol</u> <u>Terbutaline</u>	• Acute asthma • Symptom relief during maintenance treatment of asthma and COPD • Protection against exercise-	For oral and parenteral use consider: *Cardiovascular disorders (including hypertension, ischaemic heart disease, heart failure, arrhythmias)*—risk of cardiovascular adverse effects.	**Common** tremor, palpitations, headache **Infrequent** hyperglycaemia (high dose), tachycardia, muscle cramps, agitation, hyperactivity in children, insomnia **Rare**

Medication	Indications	Contraindications / Precautions	Side effects
	induced asthma	*Hyperthyroidism*—risk of cardiovascular adverse effects. *Diabetes*—risk of hyperglycaemia (high dose). *Treatment with other sympathomimetic amines*—may increase adverse effects (tremor, tachycardia, headache); avoid combination or adjust dose as necessary	paradoxical bronchospasm, allergic reactions including urticaria, angioedema and anaphylaxis, lactic acidosis (below)
Sodium chromoglycate Cromoglycate	Maintenance treatment in persistent asthma Protection against exercise-induced asthma		**Common** cough, throat irritation, bitter taste, transient bronchospasm **Rare** allergic reaction including severe bronchospasm
Leukotriene antagonists Montelukast Zafirlukast	Maintenance treatment in asthma		**Common** headache, abdominal pain, diarrhoea **Rare** Churg–Strauss syndrome (below), allergic reaction including urticaria, angioedema and anaphylaxis **Churg–Strauss syndrome** Cases have been reported with both montelukast and zafirlukast; the syndrome may have predated leukotriene-receptor antagonist treatment, or been unmasked when corticosteroid treatment was reduced; however, a causal role cannot be totally excluded.
Inhaled corticosteroids Beclomethasone Budesonide Ciclesonide Fluticasone	Maintenance treatment in persistent asthma Maintenance treatment in severe COPD with frequent exacerbations	***Precautions*** *COPD*—inhaled corticosteroids may increase risk of pneumonia. *Smoking*—asthma patients who smoke may respond less well to inhaled corticosteroids than non-smokers and may require higher doses.	

Medication	Indications	Contraindications / Precautions	Side effects
		Pregnancy Encourage pregnant women to continue using inhaled corticosteroids.	
Oral corticosteroids	Used in a wide range of conditions for their anti-inflammatory and immunosuppressant effects	*Latent TB*—may be reactivated; *Peptic ulcer disease*—corticosteroids may increase the risk of peptic ulcers. *Diabetes*—corticosteroids worsen diabetes control and may cause hyperglycaemia in non-diabetics. *Hypertension, heart failure*—may be worsened due to sodium and water retention (mineralocorticoid effect). *Psychiatric disorders*—may be exacerbated. *Glaucoma*—intraocular pressure may increase. *Osteoporosis*—long term corticosteroid use increases the risk of osteoporotic fractures and accelerates bone loss. *Myasthenia gravis*—increased muscle weakness may occur during the first few weeks of treatment with corticosteroids; seek specialist advice.	**Common** adrenal suppression, increased susceptibility to infection, masking of signs of infection, sodium and water retention, oedema, hypertension, hypokalaemia, hyperglycaemia, dyslipidaemia, osteoporosis, fractures, increased appetite, dyspepsia, delayed wound healing, skin atrophy, bruising, acne, hirsutism, growth retardation in children, myopathy, muscle weakness and wasting, fat redistribution (producing cushingoid appearance), weight gain, amenorrhoea, psychiatric effects (below) **Infrequent** osteonecrosis, particularly of the femoral and humeral heads *Intra-articular injection*: headache, flushing, rashes, acute post-injection flare reactions, injection site irritation, joint discomfort (brief), increased blood glucose concentration (temporary) **Rare** peptic ulceration, posterior subcapsular cataracts, glaucoma, hypersensitivity reactions *Intra-articular injection*: periarticular calcification (reversible), arthropathies, progressive cartilage damage, muscle wasting, skin and subcutaneous tissue atrophy, skin pigmentation changes, sterile abscess formation **Psychiatric effects** Include euphoria, hypomania, depression, disturbances of mood, cognition, sleep and behaviour. Delirium or psychosis are less

Medication	Indications	Contraindications / Precautions	Side effects
			common.
Ipratropium bromide	Severe acute asthma Maintenance treatment in COPD and severe asthma	*Closed angle glaucoma, prostatic hypertrophy*—risk of aggravation.	**Common** dry mouth, throat irritation **Rare** urinary retention, constipation, acute angle closure glaucoma, dizziness, palpitations, allergy (eg itch, rash, angioedema, anaphylaxis)
Theophyllines Aminophylline Choline theophyllinate Theophylline	Severe airways obstruction, including acute asthma (aminophylline) Maintenance treatment in severe asthma and COPD	*GORD*—theophyllines increase gastric acid secretion and relax gastro-oesophageal sphincter. *Arrhythmia*—may be exacerbated. *Heart failure, pulmonary oedema, severe hypoxia*—reduce theophylline clearance; smaller dose may be needed. *Thyroid dysfunction*—hyperthyroidism increases theophylline clearance while hypothyroidism decreases its clearance; monitor theophylline concentration and adjust dose as needed when treating thyroid dysfunction. *Smoking*—increases theophylline clearance; larger dose may be needed. *Epilepsy*—theophyllines may lower seizure threshold. *Acute febrile illness, viral infection*—possibly increase theophylline concentration. *Treatment with beta$_2$ agonists*—increases risk of hypokalaemia; monitor potassium concentration in severe asthma.	Theophyllines have a narrow therapeutic range; toxicity is closely related to plasma theophylline concentration. **Common** nausea, vomiting, diarrhoea, gastro-oesophageal reflux, headache, insomnia, irritability, anxiety, tremor, palpitations **Rare** seizures, arrhythmias (at high concentrations), tachycardia
Magnesium	Severe airway	Need cardiac monitoring	**Epigastric or facial warmth,**

Medication	Indications	Contraindications / Precautions	Side effects
sulphate ---------- -- Long acting beta agonists <u>Eformoterol</u> <u>Salmeterol</u>	obstruction, including acute asthma ---------- Maintenance treatment of asthma (including nocturnal and exercise-induced asthma) in patients receiving inhaled or oral corticosteroids Maintenance treatment of COPD	----------	**flashing, pain and numbness at infusion site, dry mouth, malaise. Rapid IV infusion may precipitate hypotension, nausea, respiratory depression and cardiac arrhythmias.** **----------** **Common** tremor, palpitations, headache **Infrequent** hyperglycaemia (high dose), tachycardia, muscle cramps, agitation, hyperactivity in children, insomnia **Rare** paradoxical bronchospasm, allergic reactions including urticaria, angioedema and anaphylaxis, lactic acidosis (below)

7. Develop an asthma management plan for Adrian that outlines the acute and ongoing management, as well as the plan for future exacerbations.

ASTHMA ACTION PLAN

Name: …… Date: …… Best Peak Flow* ……..……
**Not recommended for children under 12 years*

<u>WHEN WELL</u>
Asthma under control (*almost no symptoms*)

Preventer …… Dose ……

Reliever …… Dose …….

Symptom controller (if prescribed) …… Dose ……

Combination medication (if prescribed) …… Dose ……

Peak flow above ……..

<u>WHEN NOT WELL</u>
Asthma getting worse (*waking from sleep, first sign of a cold, using more reliever*)

Preventer …… Dose ……

Reliever …… Dose ……

Continue Symptom controller (if prescribed) …… Dose ……

Continue Combination medication (if prescribed) …… Dose ……

Continue on this increased dosage for …….. before returning to the dose you take when well

Peak flow between and

IF SYMPTOMS GET WORSE
Asthma is severe *(difficulty with normal activity, feel that asthma is out of control)*

Start prednisolone/prednisone and contact doctor Dose ……

- **Stay on this dose until your peak flow is above …….. on two consecutive mornings**
- **Reduce prednisolone/prednisone to dose …….. daily for …… days, then cease.**

Extra steps to take: ……
When your symptoms get better, return to the dose you take when well

Peak flow between and

DANGER SIGNS
(symptoms get worse very quickly, need reliever more than 2 hourly)

Continue reliever ……

Peak flow below

Doctor's stamp and/or contact details:

Pharmacist's stamp and/or contact details:

Dial 000 for ambulance

WHEN WELL
You will
- **be free of regular night-time wheeze or cough or chest tightness**
- **have no regular wheeze or cough or chest tightness on waking or during the day**
- **be able to take part in normal physical activity without getting asthma symptoms**
- **need reliever medication less than 3 times a week (except if it is used before exercise)**

WHEN NOT WELL
You will
- **have increasing night-time wheeze or cough or chest tightness**
- **have symptoms regularly in the morning when you wake up**
- **have a need for extra doses of reliever medication**
- **have symptoms which interfere with exercise**

(You may experience one or more of these)

IF SYMPTOMS GET WORSE, THIS IS AN ACUTE ATTACK
You will
- **have one or more of the following: wheeze, cough, chest tightness or shortness of breath**
- **need to use your reliever medication at least once every 3 hours or more often**

DANGER SIGNS

- **Your symptoms get worse very quickly**
- **Wheeze or chest tightness or shortness of breath continue after using reliever medication or return within minutes of taking reliever medication**
- **Severe shortness of breath, inability to speak comfortably, blueness of lips**

IMMEDIATE ACTION IS NEEDED: CALL AN AMBULANCE

Take this Asthma Action Plan with you when you visit your doctor.

To order more Asthma Action Plans, please visit the National Asthma Council Australia website: www.NationalAsthma.org.au