Breathing
including Asthma and Anaphylaxis

Revision notes for

DFMRT Casualty Care Examination Course

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Indicating special information in “Revision Notes” presentations

NEW New information since Casualty Care in Mountain Rescue was published in 2006.

NOTE: This presentation only includes essential information. To know the subject in greater depth, you must read Casualty Care in Mountain Rescue.

Casualty Care syllabus 2009-13

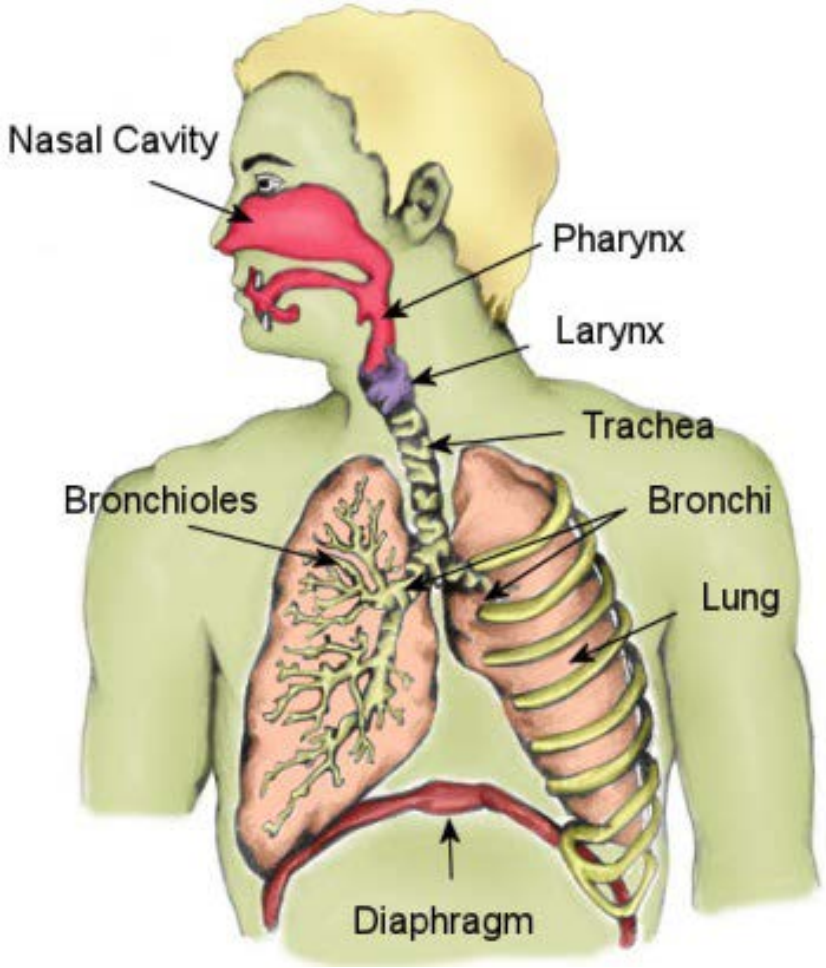
Breathing

- Appreciate the mechanism of breathing
- Be able to assess breathing and recognise abnormalities
- Understand general treatment principles and the importance of early high-flow oxygen

- Won’t cover chest injury – separate presentation tomorrow

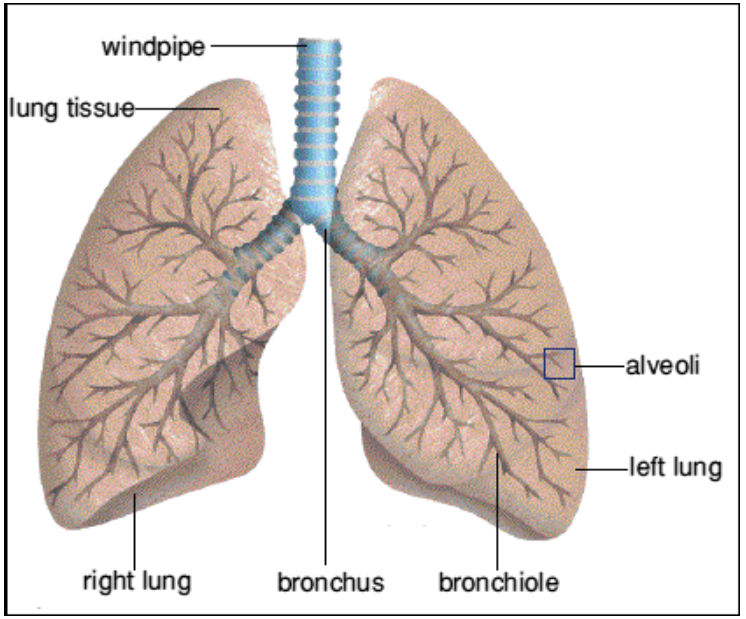
Basic anatomy – the important parts

- Windpipe (trachea)
  - Gas in and out
  - Subdivides into smaller tubes (bronchioloes)
- Lungs
  - Gas exchange
  - Very rich blood supply
- Rib cage + intercostal muscles + diaphragm
  - Enclose the lungs
  - Action of breathing in & out is due to changes in volume of chest
  - Inhalation – intercostal muscles + diaphragm contract to expand chest
  - Exhalation – muscles relax. Breathing out is passive.
- Nerve control to muscles



Basic lung anatomy

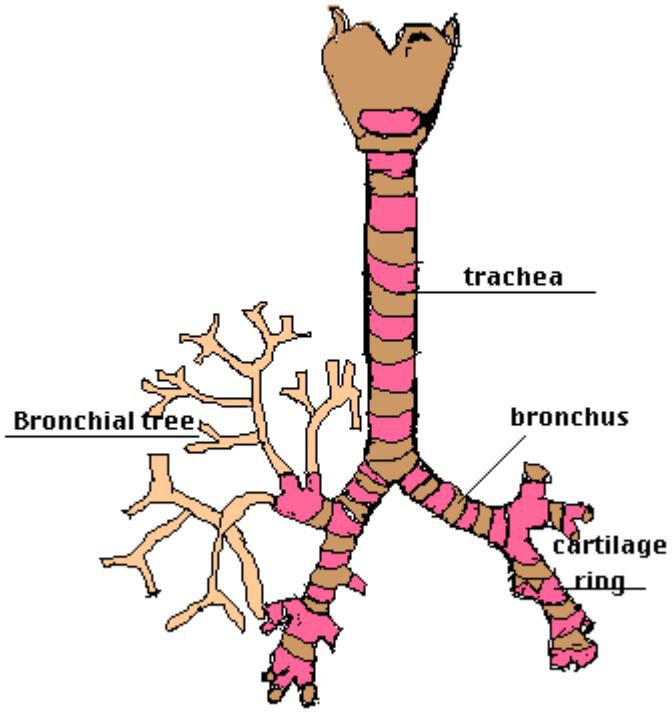
- Air breathed through nose or mouth enters lungs via the windpipe (trachea).
- Trachea splits into two smaller tubes: one to each lung (bronchus).
- Bronchi branch into smaller and smaller tubes called <u>bronchioles</u>. These can *get smaller (constrict) or larger (dilate*) by action of muscles in the bronchiole wall.



- Bronchioles end in breathing sacs (alveoli) where gas exchange occurs.
- Very rich blood supply (5 litres/min) to maximise oxygen uptake. <u>If damaged, the lung can bleed profusely</u>

Basic lung anatomy

- The system of tubes forms a tree-like structure.



Model of bronchial tree based on a lung scan

Basic lung anatomy

- Finally, bronchioles end in small sacs in the lung (*alveoli*).
- This is where gas exchange takes place (oxygen in, carbon dioxide out).
- Approx 300 million alveoli in the lungs.
- Total surface area is 70 m^2 (approx a tennis court!).

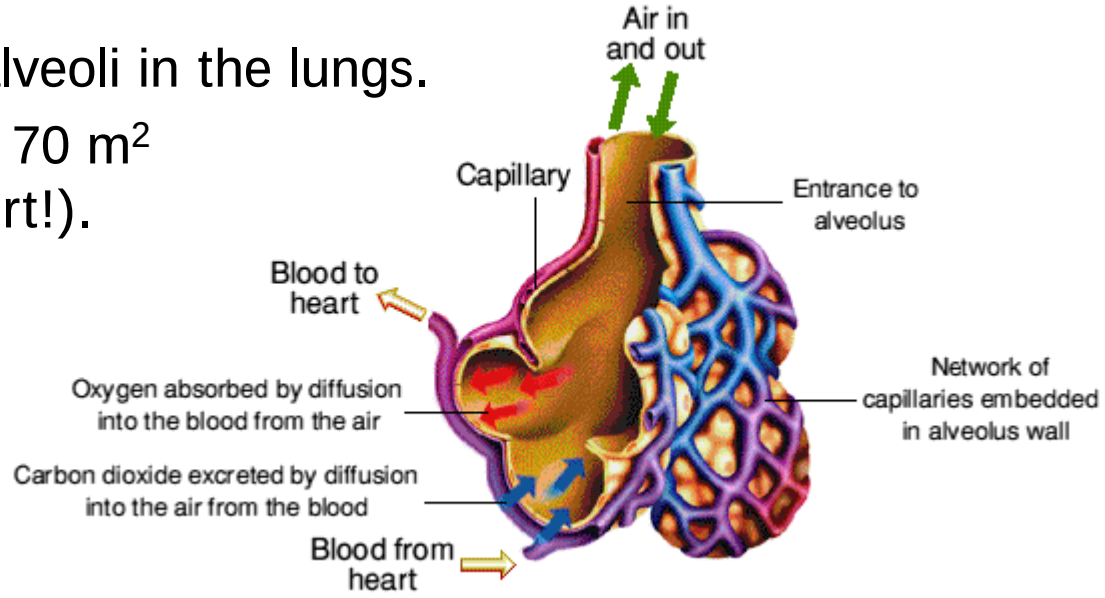


Diagram of an alveolus

Breathing – Clinical Assessment

LOOK

- Are there attempts to breathe?
- Chest movement + no air flow = obstruction

- Pattern:
  - Relaxed breathing versus struggling
  - Use of accessory muscles
  - Rate fast/slow
  - Regular/irregular

Breathing – Clinical Assessment

RESPIRATORY RATE

Important

- Common causes of ↑ respiratory rate:
  - Pain/distress.
  - Chest trauma (# ribs, pneumothorax, etc).
  - Shock.
- Common causes of ↓ respiratory rate:
  - Pain (if it hurts to breathe).
  - Head injury.
  - Drugs.

Breathing – Clinical Assessment

DEPTH

- Shallow
- Deep

CHEST MOVEMENT SYMMETRICAL?

Breathing – Clinical Assessment

LISTEN – NOISY BREATHING

- Stridor (high-pitched sound heard best on inspiration caused by airway narrowing)
- Grunting
- Wheeze
- Bubbling (= free fluid)

Spinal cord inactive due to compression or cut

- Difficulty in breathing due to paralysis of intercostal muscles
- Diaphragm paralysis if high cervical spine. This is fatal unless someone is available immediately to do artificial breathing (mouth-to-mouth, i-gel, etc.).
- Risk of extremely slow heart rate 20/min or less
  - Can be triggered by some stimulation e.g. suction of throat

Effects of environment, trauma & medical issues on breathing

- General rule is that all injury & illness increase breathing demands
  - Body is working harder in some way so needs more oxygen. Will also be more CO_2 to eliminate.
  - Trauma and acute medical problems are “fight and flight” situations i.e. body survival is at risk.
  - Breathing mechanism may become less efficient so RR has to compensate for decreased size of breath e.g. chest injury; pain on breathing due to fractured ribs.
  - Major bleeding means less oxygen carried in the blood (because there is less blood), and yet demands have increased.
  - Emotional overlay can aggravate changes.
- The bigger the change from normal, the more ill the casualty
- Most obvious sign is increased respiratory rate

Special case - Head injury as it affects breathing control

- R Rate may depend on what damage has occurred inside the skull
- As such, RR may be wildly abnormal (e.g. extremely fast) due to deranged control rather than because of changes in general body oxygen requirements

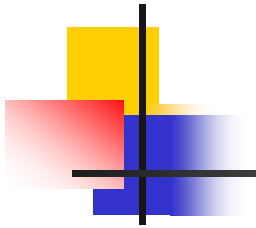
Assessing oxygenation

- Assess how effective Airway + Breathing are:
  - Colour (cyanosis – see below).
  - Pulse oximetry (normal ≈ 96% breathing air).

- Observe and record TRENDS.
- Act early.
- ?Conserve oxygen supply by ↓ flow rate if SpO_2 OK.

CYANOSIS

- Cyanosis is a blue discoloration of the skin due to lack of oxygen.
- Most important is central cyanosis i.e. blue lips
- Peripheral cyanosis common if casualty is cold & indicates poor oxygenation of extremities only.
- Cyanosis is not present if the patient is very anaemic (e.g. after extreme bleeding).
- Colour vision is not as sensitive as a pulse oximeter in detecting falls in blood oxygen levels. Therefore, do NOT wait until the casualty looks blue.



Pulse Oximetry

Pulse oximetry – “saturation” is not the same as “quantity”

Important

- Saturation does not indicate how much oxygen is being carried.
- It simply answers the question: “Is the haemoglobin (Hb) carrying as much as it can?”
- The more Hb you have, the more oxygen can be carried around to the tissues. In MR, bleeding reduces the amount of Hb in the blood and therefore reduces the amount of oxygen that can be carried by the blood.

Pulse oximetry Pitfalls – Technical Problems

- Movement artefact e.g. shivering
- Electromagnetic interference including light
- Incorrect positioning e.g. not applied correctly to the finger, or put on too tightly
- Nail polish
- Battery failure

Pulse oximetry Pitfalls – Patient problems

- Cold peripheries
- Carbon monoxide poisoning (“confuses” the sensor in the oximeter)
- Inaccurate when SpO_2 <75%
- NB SpO_2 does NOT warn if the patient is breathing very shallowly and/or very slowly
- (Abnormal blood haemoglobins – rare)

Pulse oximetry Pitfalls – What is a ‘low’ blood oxygen saturation

DEPENDS ON INSPIRED OXYGEN CONCENTRATION

- Saturation of 92% or less on air
- Saturation of 95% or less on oxygen

Causes of falling oxygen saturation

- Patient
  - Airway obstruction.
  - Respiratory depression (drugs, brain, cord).
  - Other e.g. pneumothorax, cardiac failure, asthma.
  - Poor peripheral circulation.

- Equipment
  - Oximeter probe making poor contact.
  - Oxygen mask fallen off.
  - Oxygen supply failure.
  - Movement artefact.

Oxygenation in practice

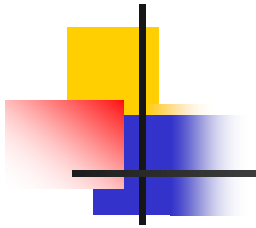
Important

- In MR, <u>you can never give too much</u> O_2.
- High flow (≈15 l/min) oxygen via face mask.
- Function of the reservoir bag:
  - Stores oxygen.
  - When we breathe, the air flows into our lungs at about 30 L/min. The O_2 is supplied from cylinder at 15 L/min.
  - Discrepancy would be made up with air sucked around mask, thus diluting the O_2. Hence the need for the reservoir bag.
  - Reservoir bag + high flow minimises likelihood of re-breathing which would raise blood level of CO_2. This is bad for the injured brain.

- If saturation is OK, you <u>can</u> reduce flow rate to conserve cylinder contents.

Maximising the oxygen carried in the blood

- High flow oxygen
- Close-fitting face mask
- Ensure a clear airway
- If possible, treat anything that is impairing breathing e.g.
  - Pain
  - Pneumothorax
  - Tight clothing
  - Drugs e.g. morphine



Asthma

Asthma

Reversible narrowing of the breathing airways

- Chronic disease
- Cannot be cured but can be controlled

Asthma – Few basic facts

- Can affect anyone
- ≅60% ASTHMATICS ARE NOT WELL CONTROLLED
- 1300 deaths in the UK in 2005. Most occur pre-hospital.
- Many deaths are potentially preventable

What triggers an asthma attack?

- Inhaled irritants e.g. pollen, dust, mites, animal fur, smoke.
- Cold air
- Exercise
- Infection (usually virus)
- Intense emotions
- Drugs
  - NSAID (non-steroidal anti-inflammatory drugs) e.g. aspirin, diclofenac, ibuprofen.
  - β-adrenoceptor blockers e.g. atenolol (used for angina).

Asthma – reaction of the lungs when exposed to a trigger

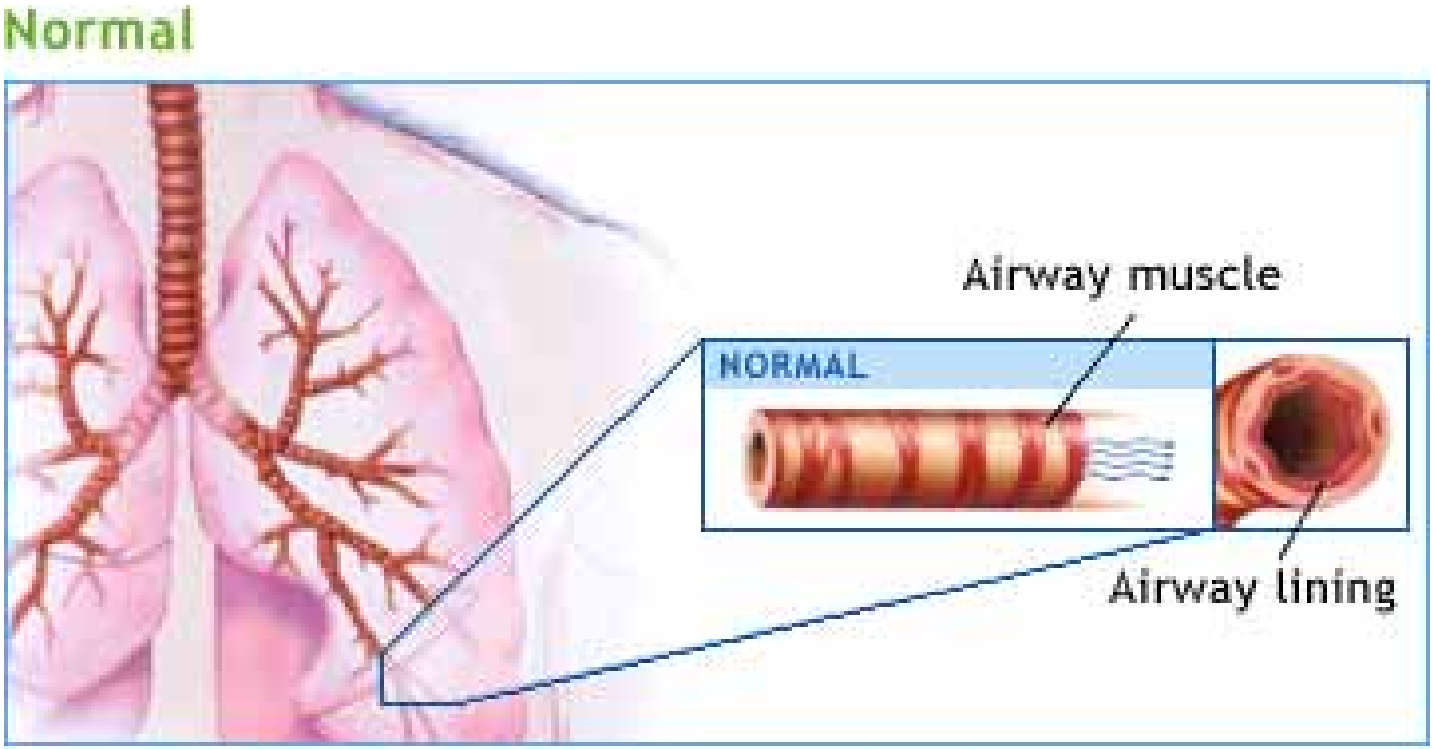
- Muscles surrounding airways of asthmatics are more sensitive than normal and start to tighten.

- Lining of lungs becomes inflamed (red & swollen)

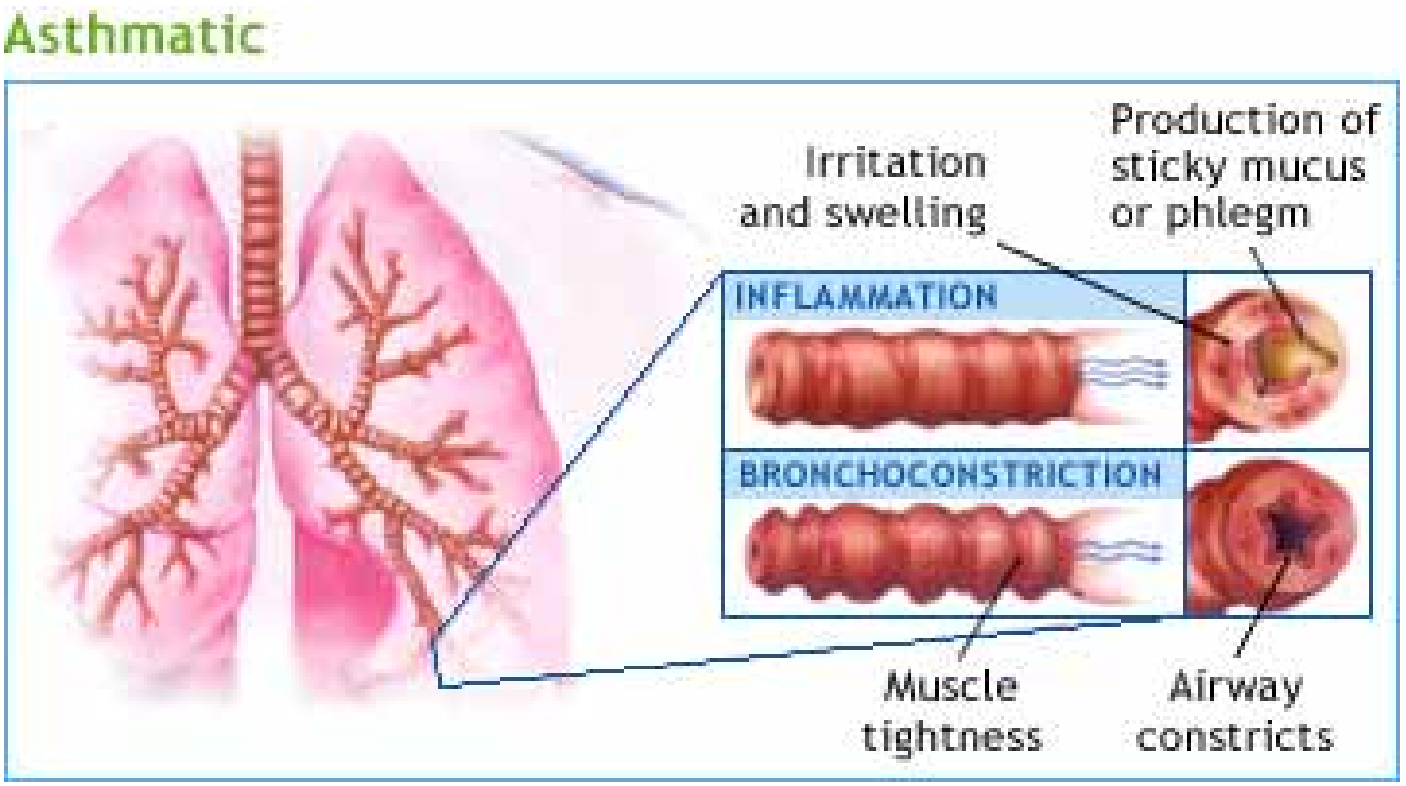
RESULT

- Air flow in & out of the lungs is partially obstructed

Airways in normal lungs



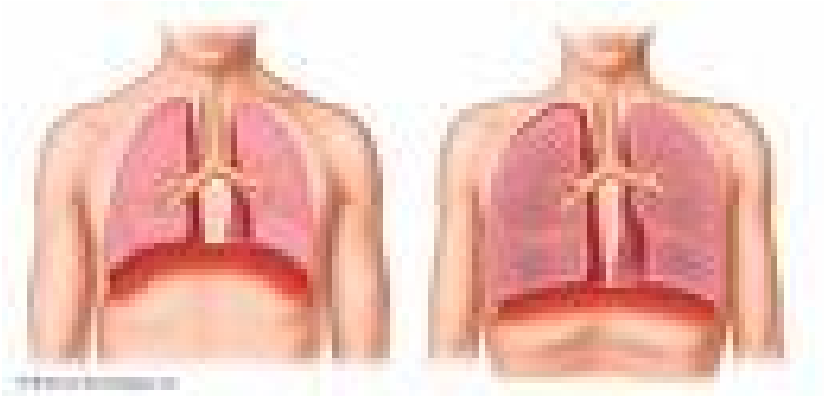
Airways in an asthmatic having an asthma attack



Asthma – typical symptoms

- Coughing
- Shortness of breath
- Difficulty in breathing
- Tightness in the chest
- Anxiety
- Worse at night

Asthma – clinical signs



- Hyperinflated chest (see fig)
- Audible wheeze
- Shortness of breath
- Working hard at breathing
- Using accessory breathing muscles around neck
- Rapid pulse
- Extreme anxiety
- Nostrils flaring
- Unable to speak a whole sentence – extremely serious

Asthma – What will the patient use to treat an attack?

- Salbutamol (or similar drug):
  - Inhaler usually coloured blue.
  - Chemically related to adrenaline.
  - Often referred to as a “reliever”.
  - Acts within a few minutes on muscle surrounding the airways to make them open the airways.

Asthma – What will the patient do/use to prevent an attack?

- Avoid known triggers
- Inhaler
  - Many colours (brown, red, orange, beige, white).
  - Often referred to as “preventer”
  - Often contains a steroid
  - Should be used regularly
- Tablets e.g. prednisolone (a steroid)

Features of moderate acute asthma

- Able to talk fairly normally
- Respiratory rate
  - Adult: ≤25/minute
  - Child 2-5y: ≤40/minute
  - Child 5-12y: ≤30/minute
- Pulse rate
  - Adult: <110/minute
  - Child 2-5y: ≤140/minute
  - Child 5-12y: ≤125/minute
- SpO_2 ≥92% on air (and more likely >95%).

Features of severe acute asthma

- Cannot complete sentences in one breath
- Respiratory rate
  - Adult: >25/minute
  - Child 2-5y: >40/minute
  - Child 5-12y: >30/minute
- Pulse rate
  - Adult: >110/minute
  - Child 2-5y: >140/minute
  - Child 5-12y: >125/minute
- SpO_2 ≥92% on air in adults. May be <92% in child.

Features of life-threatening acute asthma (extremely rare on mountains)

Any of the following:

- *Cannot speak*
- *Feeble respiratory effort. Obviously exhausted*.
- *Silent chest* (*i.e. no audible wheeze*)
- *Confusion, drowsiness, coma*
- *Cyanosis*
- *SpO_2 <92% on air* (*may in low 80's*)
- Pulse rate can be anything. Usually fast, *but if almost dead, may be slow and irregular*
- Low blood pressure (hypotension)

Asthma – MR treatment of an attack

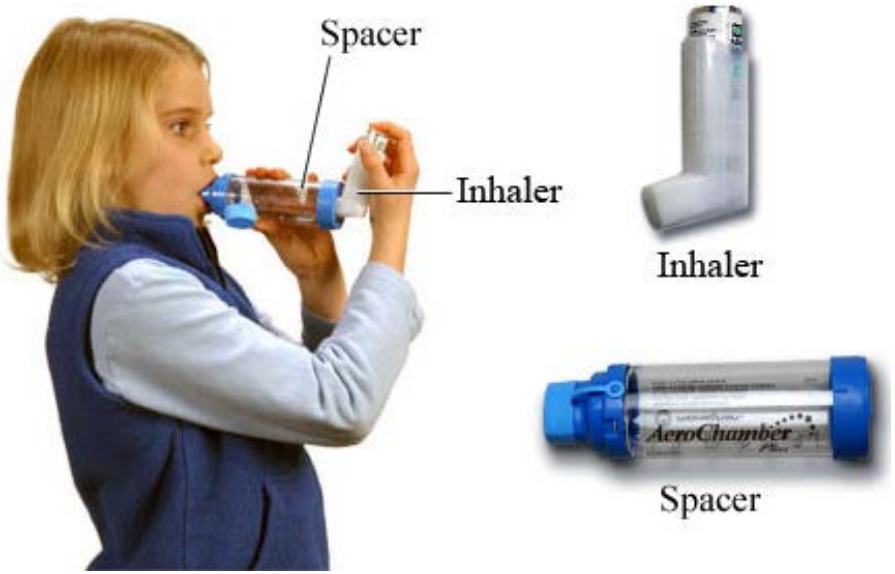
- Remove trigger if possible.
- Medical treatment:
  - Oxygen to keep SpO_2 >92%
  - Keep casualty warm
  - Allow casualty to sit up. NEVER force an asthmatic to lie down.
  - Salbutamol via spacer or nebuliser (see next slides)
  - Ipratropium (*atrovent*) via nebuliser
  - Can mix salbutamol + ipratropium together in a nebuliser
  - **Measure & record respiratory rate, pulse rate and SpO_2 regularly and watch for adverse trends**
- Exclude tension pneumothorax

For information

- Adrenaline (0.5 mg IM or subcutaneous) – can be used in an extreme emergency where there is no response to salbutamol or ipratropium *(atrovent)*.

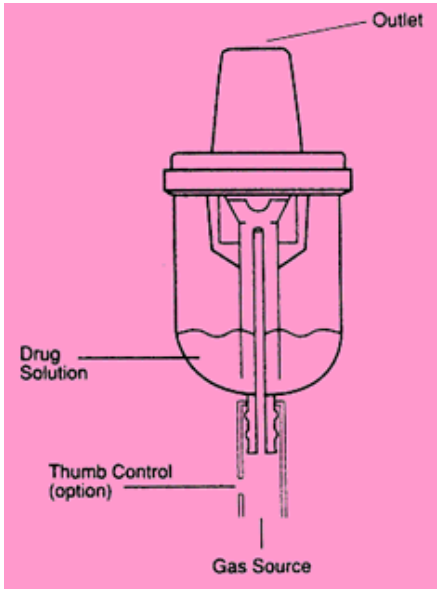
Asthma – MR treatment of an attack: Inhaler with Spacer

- Makes inhalers easier to use
- Put one puff in spacer and breathe in deeply through it and hold breath for 10 seconds if possible. Repeat.
- If not possible to hold breath, just breathe in and out through spacer
- Can do it again for up to 4-6 puffs
- Take each breath ASAP after each activation of the inhaler
- Normal size breaths



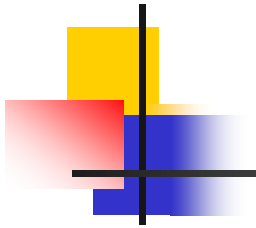
Asthma – MR treatment of an attack: Oxygen-driven Nebuliser

- Easier to use/more effective in bad cases.
- Oxygen ≅6 l/min passed through salbutamol (5 mg) to form mist, which is breathed via face mask
- Too high O_2 flow → tubing will come off bottom of nebuliser. Also, some drug will be wasted as excessive misting will occur.
- Too low O_2 flow, droplets too big to adequately penetrate lung.



Evacuation

- Admit to hospital unless the asthma has completely subsided.
- If in doubt, call the helicopter early.



Anaphylaxis

Anaphylaxis

- Severe, life-threatening allergic reaction that affects the whole body.
- More common in people who have a genetic predisposition to develop allergies.
- More common in asthmatics, esp if poorly controlled.
- Can start within seconds of exposure to trigger.
- Progresses rapidly.
- If untreated, may be fatal. 24 deaths in UK in 2007.
- If not treated, death occurs within 30 minutes of onset of symptoms.
- Incidence is rising.

Anaphylaxis – triggers

- Triggered by certain chemicals e.g.
  - Some drugs e.g. penicillin, aspirin.
  - Foods e.g. peanuts, shellfish.
  - Bee or wasp venom.
  - Latex.
  - etc
  - In many cases, the trigger is unknown.

Recognition of an anaphylactic reaction – 3 common features

- Sudden illness within minutes of exposure (especially if exposed to something that the patient knows they are allergic to).
- Rapidly progressing skin changes e.g. flushing, “nettle” rash.
- Life-threatening Airway and/or Breathing and/or Circulation problems (NB: not all A,B and C may be present).

NB: allergic reactions that are not life-threatening (i.e. no A, B or C problems) is not anaphylaxis

Anaphylaxis – clinical features

Any of the following (not all may be present):

- Generalised skin flushing.
- Nettle rash or hives (M = urticaria) anywhere on body.
- Itching (skin, nose, eyes). Eyes may water.
- Sense of impending doom.
- Swelling of lips, tongue, throat.
- Difficulty swallowing or speaking.
- Severe asthma.
- Alteration in heart rate (usually fast, but can be slow). Irregular heart rhythm. Can be cardiac arrest.
- Low blood pressure (M = hypotension) so patient feels weak.
- Can trigger an angina attack in susceptible people.
- Collapse or unconsciousness.
- Abdominal pain, nausea, vomiting, diarrhoea.

Urticaria

- Looks like nettle-sting rash.
- Pink.
- Raised.

For information

- The term "urticaria" comes from the latin name for nettle which is *Urtica*

Anaphylaxis – treatment

❶ REMOVE THE TRIGGER IF POSSIBLE

- Stop any drug.
- Remove the bee sting. Early removal is more important than the method of removal.

❷ IM ADRENALINE IS LIFE-SAVING

❸ Other management

- Clear airway.
- Oxygen.
- Put patient in most comfortable position for breathing. If breathing is OK but BP is low, lie them flat.

Anaphylaxis – treatment

IM ADRENALINE IS LIFE-SAVING

- Works best if given ASAP after onset. Response is not as good if there is a delay in administering the drug.
- IM is the safest and most effective route.
- Constricts blood vessels helping to bring blood pressure up.
- Strengthens heart beat.
- Opens narrowed bronchi (M = bronchodilation).

- Can be repeated after 5 minutes.

- Can also use salbutamol for the wheeze (M = bronchospasm).

Anaphylaxis – treatment

IM ADRENALINE IS LIFE-SAVING

- 0.5 mg (500 μg = 0.5 ml = half an ampoule) in adults and children>12 years.
- 0.3 mg (300 μg = 0.3 ml) in children age 6-12 years.
- 0.15 mg (150 μg = 0.15 ml) in children age <6 years.

NEVER GIVE ADRENALINE IV FOR ANAPHYLAXIS UNLESS YOU HAVE BEEN TRAINED HOW TO DO IT

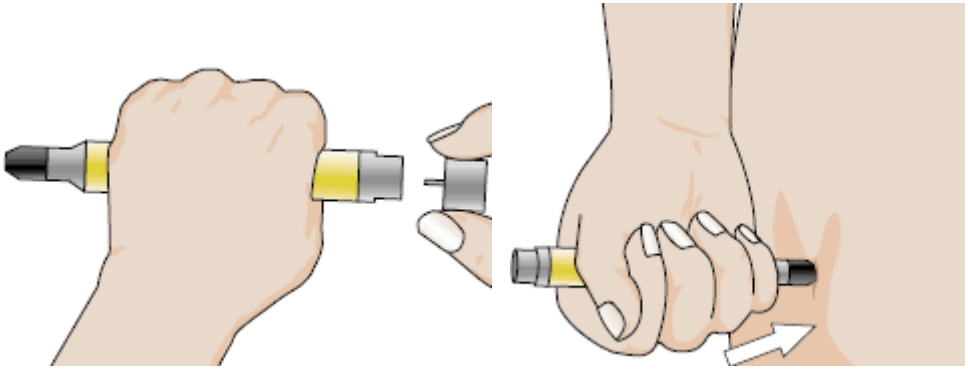
Anaphylaxis – treatment

- People who are known to be at high risk may carry an adrenaline "pen" with them. There are two types:

- EpiPen
  - (= epinephrine pen)
  - Fixed dose: 150μg (children <8 years) and 300μg for older children/adults.
  - Fires automatically.

- AnaPen
  - Same principle but must be fired manually.
  - Fixed dose:
  - 150μg (children <8 years) – called AnaPen Junior.
  - 300μg for older children and small adults (30 – 60 kg).
  - 500μg for older adults > 60 kg.

Instructions are printed on casing



- Remove grey safety cap.
- Place black tip against thigh at 90º.
- Press hard into thigh until auto-injector mechanism functions (should click).
- Hold in place for 10 seconds. Then remove.
- Massage area for several seconds.

http://www.anapen.co.uk/

How to administer the Anapen®

1. Remove the black needle cap

2. Remove the black safety cap from the red firing button

3. Hold Anapen® against the outer thigh and press the firing button

4. Hold Anapen® in position for 10 seconds

Anaphylaxis – information on Advanced additional treatment

- Cannulation + IV fluids help bring up blood pressure.
- Some patients get a very slow heart rate (M = bradycardia).
  - Usually corrected by epinephrine.
  - Alternatives are atropine or external pacemaker (neither currently carried).
- In patients taking beta-blockers e.g. atenolol, anaphylaxis may resist treatment e.g. BP and heart rate stay low.
  - Try further doses of epinephrine and IV fluids.
  - Glucagon may help.
- Laryngeal swelling can occasionally be severe. If it does not respond to epinephrine, a tracheostomy would be needed.

Evacuation

- Admit to hospital even if symptoms subside as 25% re-occur over next few hours.

Skills

Essential

- Recognise abnormal breathing
- Count respiratory rate accurately
- Correct use of pulse oximeter & interpretation of readings
- Correct use of oxygen mask with reservoir bag

Desirable

- Artificial ventilation for a casualty who is not breathing

Scenarios

Consider the breathing management in the following (either as isolated problems, or in combination):

- Anaphylaxis
- Asthma
- Combative casualty with head injury
- Falling blood pressure
- Falling SpO_2
- Head injury
- Major haemorrhage
- Major limb fractures
- Rib fracture
- Spinal injury
- Uncontrolled seizures