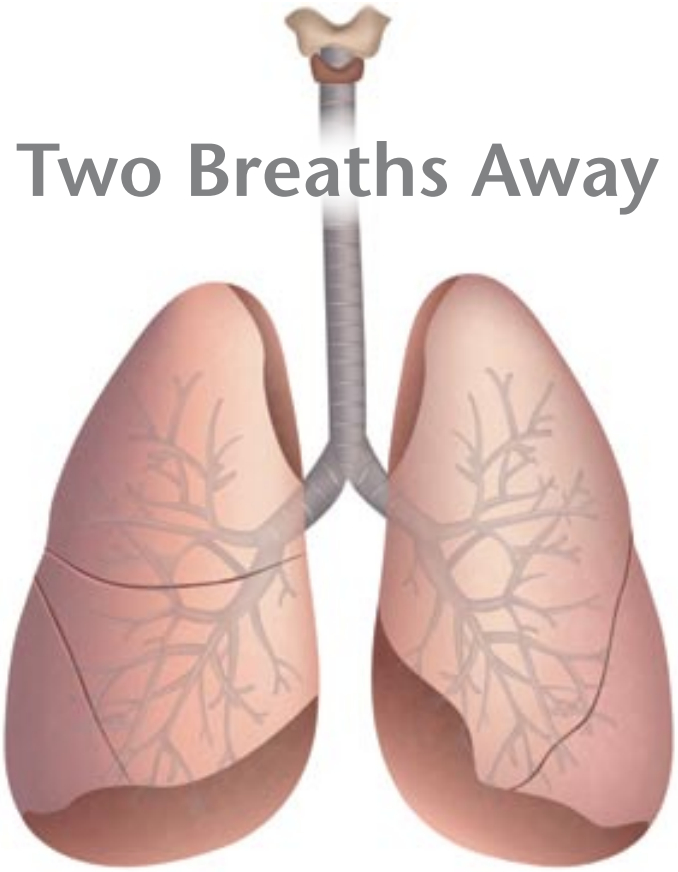
By Professor Chee Yam Cheng, Editorial Board Member

Two Breaths Away



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COUGH

This is both a symptom and a sign. It is a distressing symptom and if persistent can lead to broken ribs. The resulting pain serves in a beneficial way to prevent more coughing. In assessing cough from the history, ask if the cough is troublesome at night, meaning 2 am to 3 am in the dead of the night or also referred to as the early hours of the morning. In particular we want to know if the patients have gone to sleep, then are suddenly awakened by cough (with wheeze and breathlessness). All three could be present or just cough alone.

THE 3 AM COUGH

There are three causes for a 3 am cough. These are bronchial asthma, acute left ventricular failure (LVF) (paroxysmal nocturnal dyspnoea) and gastrooesophageal reflux disease (GERD). The patient's age, habitus and present chronic illnesses will help the doctor make the right diagnosis as to which is most likely to be present. The young and thin probably has asthma. The older and fatter probably has GERD and the elderly with hypertension and diabetes of some standing will have heart failure.

Why the 3 am cough? If a patient is coughing day and night, before going to sleep and during sleep, the causes may not be any of the above three. He goes to sleep surprisingly cough-free and is awakened at 3 am by the cough. This is the scenario I refer to. Why does it happen?

It has to do with the activity of the vagus nerve. As you will remember, it is the tenth cranial nerve, with both motor and sensory components (a twig supplies the external auditory canal just inside the tragus of the ear) and is part of the parasympathetic nervous system. The sympathetic nervous system is responsible for fight and flight reactions. The parasympathetic is responsible for vegetative functions, usually not in our conscious realm. So for the foregut and the lungs (as explained in the previous article, the lung arises from a bud from the foregut), the vagus is the parasympathetic nerve that controls its motility, propulsion and retropulsion. It also controls gastric acid secretion. Before H. pylori was discovered as the cause of peptic ulcer disease, surgeons were busy removing stomachs (to remove the acid-producing glands) combined

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with sectioning the vagi nerves (to reduce acid secretion by the remnant stomach). So partial gastrectomy and vagotomy were in vogue as a cure of peptic ulcer disease. But the surgeons also had to do a pyloroplasty. Otherwise the food would not leave the stomach as there were no vagi nerves to stimulate propulsion.

GERD

In the context of GERD, reflux of acid gastric contents occurs when the lower oesophageal sphincter is relaxed. This happens when vagal tone is high. High sympathetic tone on the other hand constricts the sphincter. Vagal tone is increased as the sympathetic tone is decreased. This balance shifts in a diurnal cycle. So when we are wide awake preparing for fight or flight, the sympathetic system is supreme. We breathe faster, our nostrils flare; our heart palpitates, our pupils are wide open and our skeletal muscles are tense, ready to spring into action. The parasympathetic system at this time is therefore almost asleep. The gut is at rest, the smooth muscles relaxed but all sphincters are tightly closed. But at 3 am, the vagus is most active and vagal motor tone at its greatest. So blood pressure, heart rate and respiratory rate fall. Bronchomotor tone is high and bronchonstriction occurs. A little acid from the stomach aspirated down the lungs will provoke instantaneous coughing. Wheeze may occur if the bronchoconstriction is of sufficient severity.

LVF

The causes of left ventricular failure are many. Hypertension, valvular heart disease, ischemic heart disease are the common ones. But why the 3 am failure? As mentioned previously, increased vagal tone slows the heart and lowers the blood pressure. As cardiac output is the result of stroke volume times the heart rate, lowering the latter means decreasing the output. This in turn leads to pulmonary congestion and the patient awakes suddenly very breathless, wheezing and coughing pink frothy sputum, the picture of acute pulmonary oedema. Since blood pressure falls, this means the diastolic pressure also falls. As you well know, the heart receives its oxygenated blood supply via the coronary arteries which are filled only in diastole. In systole, the heart is like a hard rock squeezing all the blood out of the ventricles so there is zero coronary blood flow. So if the diastolic pressure falls at 3 am, then there will be less filling of the coronary arteries especially if they are narrowed at the ostia (by aortic root disease) or along its length by atheroma.

BRONCHIAL ASTHMA

In contrast to the previous picture, sometimes called cardiac asthma, in bronchial asthma, the increased vagal tone leads to bronchoconstriction via greater bronchomotor tone. In normal people, this increased tone is at most 7% to 10% more than in the day. This is reflected in the measurements of FEV_1 or PEFR over a 24-hour time period. There will be this dip at 3 am, which will rise again towards dawn. This variation does not cause any sleeplessness nor awakening in normal people. This dip is exaggerated in asthmatics where by definition the reversible variation is 15% or more. So variations (spontaneous or otherwise) of less than 10% is considered as normal. But if it exceeds 15% and is reversible (spontaneously or with treatment), then it qualifies for bronchial hyperreactivity – a necessary condition for asthma. But by itself, its presence does not make the diagnosis of asthma. In its absence, it would not be rational to diagnose asthma.

So an asthmatic starting with a lower than normal FEV_1 (or PEFR) would at 3 am, bronchoconstrict further because of heightened vagal tone. This would be sufficient to cause a clinical asthmatic episode easily relieved by a puff of ventolin through the metered dose inhaler. The attack may even be preventable by a long acting bronchodilator drug like salmeterol taken at bed time.

The very telling question to ask asthmatics then, is about their sleep (or lack of sleep). Ensuring a good, uninterrupted night's sleep is the first aim of improving an asthmatic's condition. Thereafter, the next improvement should be less day attacks. So settle the night first. If your treatment works, this beauty sleep will return.

COUGH ASSESSMENT

There are some pertinent questions to ask when eliciting more history about cough. Besides the nocturnal cough described above, it is useful to know if there is sputum (not saliva) produced. Is it a dry or wet cough? The latter can come about only from airway secretions – mucus mixed with air, and fluid in the alveolar sacs. The fluid could be exudate or transudate depending on whether there is inflammation (pneumonia). A wet cough therefore originates in the bronchi and further distally. Tracheal irritation and inflammation gives a dry painful cough felt retrosternally. A dry cough could originate in the bronchi in the early stages but it usually reflects ENT causes. I have referred to the ear being innervated by the vagus which when irritated can give rise to cough. The throat is the more usual reason for a

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dry painful cough – be it a pharyngitis, tonsillitis or laryngitis. In the latter, the voice would be affected. The involvement of the nose and sinuses usually results in blockage and discharge from the nostrils. Sneezing and itch can be present. Cough can develop through post nasal drip. This means the secretions drip over backwards over the hard and soft palate (instead of forward) and fall upon the larynx and into the trachea thus initiating the cough reflex. Coughing can also be voluntary.

So cough can be a symptom, and can also be a sign. When we request the patient to cough, he can do it voluntarily and we do so to confirm how wet it is and to cause a sputum specimen to be produced and collected. As we listen to a patient coughing (reflexively or voluntarily), we take note of how guttural it sounds – meaning how deep is its origin within the chest. That way we have some idea of whether it is bronchitis or pneumonia. And this is very different from a cough originating in the throat.

The sputum itself is informative especially for the changes over time, be it a few days or weeks. Coloured sputum means inflammation – it could be yellow or green. White usually reflects mucus production from the airway goblet cells. (Remember Reid's index to diagnose chronic bronchitis in smokers.) Inflammation does not equal infection and if there is no infection, the question of antibiotics (mainly for bacteria) does not arise. Asthmatics also have inflamed airways due to eosinophilic infiltration.

Finally, bronchiectasis is the classical example of loads of sputum being produced in ectatic airways. Early morning cough brings up overnight collections. With proper postural drainage and chest percussion, the patient can be free of cough for the rest of the day.

WHAT IS COUGH?

A cough is a forced expiratory effort against a semi-closed glottis. The reflex is initiated via vagal sensory free nerve endings in the mucosa of the airways as well as by nerves in the lung interstitium. With airway inflammation, these endings are exposed and so are easily activated. Bronchial hyperreactivity is the result. Simple stimuli which would otherwise not cause a cough reflex will now do so. In the expiratory effort, the diaphragm is the largest muscle involved. Chest wall muscles, external, internal and inner intercostal muscles, also participate. Their innervations are the somatic thoracic intercostal nerves and the phrenic nerve from cervical 3 and 4 segments for the diaphragm.

A patient with a tracheostomy has great difficulty coughing. Hence tracheal toilet by the nurse or relative is necessary to rid the airway of secretions and debris. If the hole of the tracheostomy is closed by a finger or trocar, a voluntary cough may be executed.

PERCUSSION

So what is percussion? What is a percussion instrument? Who plays the drums or the huge cymbals? Why make all that noise? Because empty vessels make the most sound.

In chest percussion, you need both hands to be in working order – free of arthritis, free of amputation and free of long nails – just like playing the piano. One hand contributes a pleximeter finger: this is placed simply over the area to be percussed. On the chest, this usually means over the length of a rib or a rib space. There should be no air gap between the skin of your pleximeter finger and the patient's skin. The other hand (usually the right if you are right-handed) contributes the percussion finger (just like the piano key action inside the unseen part of the piano). The objective is to hit your percussion finger onto one pleximeter finger with the wrist of your right hand being the fulcrum of motion, and lifting the finger off immediately it has hit. Imagine playing the drums: you lift the sticks off after hitting the skins. Imagine clashing the cymbals: you do not keep them glued to each other; with a flourish you move them apart after clanging them together. If you do not, then it is pretty dead percussion. In live percussion, the waves of energy continue to flow through the medium and are not dampened down.

So you can feel and hear the percussion note. The energy you have imparted would flow through hollow space but it would be reflected back to you by fluid in a pleural effusion. This back reflection of energy makes the percussion painful. The fluid could be anything from blood, urine, lymph, exudate or transudate.

So put a needle in to find out. The chest X-ray cannot tell you what the fluid is. The other four percussion notes that you hear, other than the stony dull of fluid, are obvious: too much air to no air, hyperresonance (but you cannot tell if the air is intra or extrapleural – meaning a pneumothorax), normal resonance, impaired or dull. Impaired means a mixture of air and tissue but more tissue than air compared to normal lungs, for example, fibrosis and collapse. Dull means consolidation – no air. It could be made solid by pneumonia (inflammatory cells), normal lung tissue but in abundance or abnormal tissue, for example, cancer cells.

As with inspection, there is the great advantage

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of comparison between the right and left sides. Of course you make allowance for the presence of the heart on the left and the liver on the right. It is rare to use percussion in cardiac examination but essential to do so for liver examination because its upper border cannot be palpated, only percussed. This way the length of the liver can be measured in the mid-clavicular line and an assessment made whether the liver has enlarged, shrunken or is its normal size but pushed way down into the abdomen by air trapped in the lungs.

Then there is direct percussion without the intervening pleximeter finger. The percussion finger hits directly on the chest. Usually this is applied onto the clavicle. As pointed out previously, for a proper examination of the upper lobes, the apex must be percussed. The supraclavicular fossae and the clavicle overlie the upper lobes. It is therefore inadequate to begin percussion from the clavicles downwards.

SEMI-CONCLUSION

In this article, I have explained how I use the complaint of cough to help analyse the patient's illness. The role of the vagus and the diurnal variation in vagal tone are instrumental in the analysis. Cough is a symptom (because the patient complains about it); cough is a sign because you use it in the consultation process to confirm its presence and the presence of any sputum (not saliva). Cough is voluntary; cough is reflex. In the latter, it is meant to be protective clearing the airway of whatever might be obstructing air flow. But if it is irritating and persistent, ribs may break. If severe, the patient may faint (cough syncope); cough mixtures do not work. Attack the cause of cough.

Percussion is an important step in chest examination and good technique is necessary to detect abnormality.

The final article will deal with chest pain, auscultation and simple bedside tests. ■