DON’T BITE OFF MORE THAN YOU CAN CHEW – A CASE OF POST-OBSTRUCTIVE PULMONARY OEDEMA

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SUMMARY
A 78-year-old man presented to the accident and emergency department (A&E) having choked on a bacon sandwich at lunch. A paramedic crew had attempted the Heimlich manoeuvre but was unsuccessful. On admission, he was cyanosed and unresponsive with saturations of 85% of 15 litres of oxygen. He was acidic. Chest examination revealed left upper zone crepitations. Chest x-ray showed bilateral haziness more on the left upper lobe. He was treated with high flow oxygen and back blows were attempted. An emergency laryngoscopy showed a large piece of bacon obstructing his airway and this was removed with McGill’s forceps. He was transferred to the high dependency unit (HDU) for 24 hours and discharged home the next day with a diagnosis of post-obstructive pulmonary oedema (POPE) secondary to foreign body aspiration.

BACKGROUND
This case illustrates that the pathophysiology of pulmonary oedema is not always the result of a low cardiac output, fluid overload or both. The cause in this case was heralded by an obstructed airway, most frequently seen in anaesthetics as a consequence of laryngospasm(1,2). Fluid overload and low cardiac output do not feature in POPE, instead fluid leaks into the alveoli from the capillary beds supplying blood to the lungs. Diuretics and inotropes have not been proven to be helpful in the treatment of POPE, the management being supportive(3).

CASE PRESENTATION
A 78-year-old gentleman presented to A&E after choking on a piece of bacon whilst eating lunch at Morrisons. He started choking at 1400 hrs and an ambulance was called at 1410 hrs. The ambulance crew attempted the Heimlich manoeuvre but this was unsuccessful. On arrival to A&E at 1440 hrs, he had stridor and was struggling to breathe. He was cyanosed with saturations of 85% on 15 litres of oxygen. His respiratory rate was 25 and a
blood gas on 15 litres of oxygen showed H+ 60.1, pCO2 6.32, pO2 12.8, HCO3 17.5, BE -7.6, and lactate was 5.8. The patient’s pulse was 89 beats per minute and his blood pressure was 92/68. He was unresponsive. On examination he had coarse left upper zone crepitations but breath sounds were heard bilaterally. Heart sounds were normal and his abdomen was soft and non-tender. The patient had a past medical history of restless leg syndrome, for which he was on co-careldopa, hypertension, ischaemic heart disease and benign prostatic hypertrophy. He was normally fit and well and lived with his wife. He was independently mobile and was a non-smoker. He had previously worked as a coal miner.

INVESTIGATIONS

An ECG showed normal sinus rhythm with ventricular ectopics and a chest x-ray showed more left upper zone haziness compared to the right lung field. (Fig.1). Blood results were essentially normal.

![Figure 1: Admission chest x-ray.](image)

An echocardiogram was subsequently performed, showing a mildly dilated left ventricle with good systolic function. There was mild mitral regurgitation into a mildly dilated left atrium. The mitral and aortic valves opened well. The right heart was normal in size with trivial tricuspid regurgitation detected. Pulmonary function tests showed a normal flow volume and transfer factor.
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DIFFERENTIAL DIAGNOSIS

A clinical diagnosis of non-cardiogenic pulmonary oedema secondary to a tracheo-bronchial foreign body was made. He was also treated for aspiration pneumonia but antibiotics were stopped after 24 hours after clinical review.

TREATMENT

The patient was given high flow oxygen and back blows were attempted. At laryngoscopy there was a large piece of bacon moving up and down with respiration on the posterior pharynx (Fig. 2). This was removed with McGill’s forceps and immediately afterwards there was a dramatic clinical improvement. The patient’s oxygen saturations increased to 99%. He was tachypnoeic with deep respirations and no obvious stridor. The patient’s conscious level slowly increased to a GCS of 13. He was given intravenous (IV) antibiotics for aspiration pneumonia after the appearances on chest x-ray. A repeat ABG showed improvement (on 15 litres of oxygen) with an H+ 49.0, pCO₂ 6.01, pO₂ 11.4, HCO₃ 21.3, BE -3.2, and lactate of 3.4. He was transferred to HDU for further observation.

Figure 2: Piece of bacon
OUTCOME AND FOLLOW-UP

An arterial line was inserted in HDU and IV antibiotics were continued. Non-invasive ventilation (CPAP) was not required. He was transferred to the ward after 24 hours in HDU. The patient was assessed by speech and language therapy and had no obvious swallowing difficulties. The patient remained well during his stay in hospital. A repeat chest x-ray 24 hours after his admission was essentially normal (Fig. 3). He was discharged home 48 hours after presenting to A&E. On clinic follow up 6 weeks later, the patient was remarkably well.

**Figure 3:** Repeat chest x-ray after 24 hours.

DISCUSSION

Incidence

A tracheo-bronchial foreign body in this case caused POPE. Upper airway obstruction secondary to foreign body aspiration is most common in people at the extremes of age. Children aged 1-3 years and the elderly, especially those with primary neurogenic disorders or decreased gag reflex (excess alcohol, seizures, stroke, Parkinson’s disease, under general anaesthesia and dementia), are at the highest risk. Inhaled material is more likely to lodge in the right main bronchus because it is more vertical than the left. Children tend to aspirate foods such as nuts, sunflower seeds and vegetables, whereas the elderly choke on meat bones, dental and medical appliances. Foreign body aspiration carries a significant mortality, around
1\%. POPE has also been reported in the following conditions highlighted in Table 1 below.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cause</th>
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<tbody>
<tr>
<td>Post-extubation laryngospasm(2)</td>
<td>Endotracheal tube obstruction</td>
</tr>
<tr>
<td>Epiglottitis</td>
<td>Laryngeal tumour</td>
</tr>
<tr>
<td>Croup(5)</td>
<td>Goiter</td>
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<tr>
<td>Strangulation(6)</td>
<td>Postoperative vocal cord paralysis</td>
</tr>
<tr>
<td>Hanging(6)</td>
<td>Near drowning</td>
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<tr>
<td>Choking(7)</td>
<td>Migration of balloon used to tamponade epistaxis</td>
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</tbody>
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In adults, the majority of cases of POPE occur following laryngospasm (60%), but airway tumours are also relatively common (20\%)(8).

**Clinical presentation**

Foreign body aspiration presents with cough or choking in 95\% of cases, but depending on where the foreign body lodges, the symptoms can vary. A large foreign body e.g. a coin may lodge in the trachea and cause cough, stridor or cyanosis. Small foreign bodies e.g. peanuts can lodge in the right main bronchus which can result in wheeze, cough and unilateral breath sounds in the unaffected side. If left for any length of time, there may be hyperinflation of the unaffected side. Smaller foreign bodies can present years after the initial inhalation with persistent suppurative lung diseases like bronchiectasis or lung abscess(9).

POPE secondary to foreign body aspiration usually presents within 60 minutes of the precipitating event(1), but the onset can be later on, as much as 6 hours after the initial insult(10). The clinical course of the disease is usually self-limiting with brisk and full resolution of both the clinical and radiological features within 24 hours, with no clinical consequences. Rarely, it can result in adult respiratory distress syndrome and death(11).

**Aetiology**

It is not exactly clear how POPE occurs but it is thought to be multifactorial and a few theories have been put forward. The first theory proposes that POPE is caused within minutes of developing acute severe upper airway obstruction or of the relief of the obstruction, by considerable fluid shifts due to changes in intra-thoracic pressure(12). Negative intra-thoracic pressure occurs when a person attempts to inhale against a closed glottis or blocked airway. During normal respiration, intra-thoracic pressure hardly falls below -5 cmH\textsubscript{2}O but in upper airway obstruction, it can be as low as -50 cmH\textsubscript{2}O(13).
Young athletic men are thought to be more susceptible to POPE because they are able to generate higher negative inspiratory pressures, due to their well-developed chest wall musculature(14). Put simply, these extremely negative pressures cause increased venous return to the right heart, decreased cardiac output and fluid shift into the alveolar space. The temporary drop in intrathoracic pressure increases blood flow to the right side of the heart, which in turn increases pulmonary venous pressure. The increase in pressure in the venous circulation produces a gradient across the pulmonary venous system (high pressure) and the pulmonary interstitium and airspaces (low pressure), resulting in fluid moving between these two areas.

The second theory proposes that acute mechanical distress and hypoxia cause damage to the alveolar epithelial and pulmonary microvascular membranes. This causes increased pulmonary capillary permeability, resulting in fluid leaking into the alveoli from the capillary beds i.e. protein-rich pulmonary oedema.

The negative pressure pulmonary oedema is not too dissimilar to the pulmonary oedema seen in patients who have congestive heart failure or volume overload states. The second mechanism i.e. leaky pulmonary capillaries, is seen in patients with acute lung injury or ARDS.

Management

The diagnosis of foreign body aspiration is usually from the history. However, in the case of children, mentally handicapped or the unconscious, this may not be feasible, so clinical signs must guide you. Foreign body aspiration can be investigated by chest radiology, including both PA and lateral films, CT chest, if the patient is stable, diagnostic indirect laryngoscopy and sometimes bronchoscopy is required to remove the object and examine both main bronchi for multiple obstructions. In an emergency, the Heimlich manoeuvre should be employed(9).

It is critical in the management of POPE, that it is recognised and treated early. Supportive care and oxygen therapy are usually all that is required in the bulk of cases. Sometimes, non-invasive ventilation (CPAP) is needed. Intubation and ventilation is usually reserved for those patients with inadequate oxygenation despite the above interventions(8).

POPE is usually self-limiting and normally resolves with 24 hours of onset, both clinically and on x-ray. The majority of cases do not require invasive haemodynamic monitoring or drug therapy i.e. loop diuretics(3). If patients were not to recover from the above measures, alternative diagnoses such as aspiration pneumonia, fluid overload, anaphylaxis and occult cardiac disease should be thought about.
REFERENCES