

## CASE REPORTS

# The "hidden" pneumothorax

M K Harkness, A Hashim, D Spence

A 61 year old female smoker with a background of chronic obstructive airways disease (COPD, FEV1 1.2/FVC 1.85: predicted 2.42/2.86), pulmonary tuberculosis, carcinoma of the breast, and coeliac disease was admitted with a six day history of progressive breathlessness associated with a productive cough. Chest auscultation showed bilateral expiratory wheeze. Admission chest radiograph showed hyperinflated lungs. She was treated for an infective exacerbation of COPD.

Five days later she became acutely unwell. Auscultation of the chest showed severely reduced air entry on the right side; the trachea was central. Urgent portable erect and supine chest radiographs did not confirm a pneumothorax. Observations: sinus tachycardia at 140 beat/min with no acute changes on 12 lead electrocardiogram, respiratory rate of 40 breath/min, decrease in systolic blood pressure to 90 mm Hg, and oxygen saturation below 90%. An intercostal drain was inserted immediately because of the very high index of clinical suspicion and it was felt that definitive treatment was required. This produced subjective and objective improvement with an improvement in oxygen saturation and blood pressure, settling of pulse and respiratory rate, and an increase in air entry on the right side. Subsequent chest radiography showed the tube to be satisfactorily placed and there was no evidence of pneumothorax. The drain was removed two days later when bubbling had ceased, again with no radiological evidence of a pneumothorax. The day after the removal of the drain the patient felt increasingly breathless, in the absence of objective findings on clinical examination. Given the diagnostic limitations of previous chest radiographs, spiral computed tomography was performed to investigate the cause of her breathlessness. This showed a right sided pneumothorax on all cuts of the tomogram (fig 1). It is most probable that the pneumothorax re-accumulated because of a further air leak after the removal of the chest drain. A second intercostal drain was re-inserted; a subsequent tomogram showed that both lungs were fully expanded with severe emphysematous change in the right middle and lower lobe and bullous emphysema on the left at the lung base.

### DISCUSSION

Spontaneous pneumothorax occurs commonly in two groups of patients: otherwise healthy young subjects who can tolerate a large air leak and older patients with emphysema, in whom even a small pneumothorax may cause severe respiratory distress. Clinical and radiological signs may be difficult to interpret, particularly in the presence of severe COPD, large bullae may mimic pneumothoraces. National guidelines have been published to assist clinical management.<sup>1</sup>

A radiological diagnosis of pneumothorax can be made only by identifying the visceral pleural line. In the erect person, pneumothorax is first evident near the apex of the chest as air rises to the apex of the hemithorax. In the vast majority of cases, the inspiratory chest radiograph is the only imaging modality required for diagnosis. When pneumothorax is strongly suspected but a pleural line is not

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**Figure 1** Computed tomography showing a right sided pneumothorax.

identified (possibly obscured by an overlying rib), gas in the pleural space can be detected by either radiography in the erect position in full expiration (the lung density is increased and volume of gas in the pleural space is constant, thus making it easier to detect the pneumothorax) or by radiography in the lateral decubitus position<sup>2</sup> (air rises to the highest point and is more clearly visible over the lateral chest wall than over the apex). When patients with suspected pneumothorax have to be examined in the supine position, gas within the pleural space rises to the vicinity of the diaphragm. Depending on the size of the pneumothorax, the result can be an exceptionally deep radiolucent costophrenic sulcus (deep sulcus sign),<sup>3</sup> a lucency over the right or left upper quadrant, or a much sharper than normal appearance of the hemidiaphragm with or without the presence of a visceral pleural line visible above it.<sup>4</sup> Other findings include visualisation of the anterior costophrenic sulcus, increased sharpness of the cardiac border, collection of air within the minor fissure, and depression of the ipsilateral hemidiaphragm.<sup>4</sup>

Cross sectional imaging has the advantage over conventional radiography of visualising lung parenchyma and the pulmonary vasculature and is now increasingly accessible at the cost of delivering a higher radiation dose. It has been shown to be superior to frontal chest radiography in making a diagnosis of pneumothorax in a supine patient.<sup>5</sup>

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# Management of adrenaline (epinephrine) induced digital ischaemia in children after accidental injection from an EpiPen

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The use of adrenaline (epinephrine) containing auto-injector devices as a treatment for severe allergic reactions is now widely accepted and EpiPens are increasingly prescribed for children. It is estimated that 5% of the paediatric population in the United Kingdom have some form of food allergy.<sup>1</sup> In a recent study assessing the extent of nut allergy in school children within the Severn NHS Trust, 26% of allergic children had an EpiPen at school.<sup>2</sup>

In association with increased prescription of these devices, there is a greater incidence of accidental auto-injection into digits, resulting in significant pain and discomfort, because of severe vasoconstriction.

The presentation of three cases over the past six months in our accident and emergency department prompted a literature search to define the most appropriate evidence based management for this situation. We conclude that the intradigital administration of phentolamine is the preferred management.

## CASE 1

A 15 year old boy was admitted with a cold and pale right thumb after accidental injection of adrenaline 0.3 mg of 1:1000 from an EpiPen he found on a bus. The injection site was on the palmar aspect of the distal phalanx of the thumb. The boy complained of pain and paraesthesia with a cold, pale thumb having a capillary refill time of five seconds.

Restoration of blood flow was attempted by warm water immersion and application of topical nitroglycerin paste. Peripheral perfusion of the digit was restored six hours later without sequelae.

## CASE 2

A 7 year old boy auto-injected his left thumb while playing at home with his own EpiPen. On arrival, the puncture mark on the thumb tip was evident, however, there were no signs of impaired peripheral perfusion. He was subsequently discharged.

## CASE 3

A 15 year old boy punctured his left thumb while experimenting with an auto-injecting device that he found in a nearby garden. The description of the device matched that of an EpiPen. On examination, his left thumb was found to be cold and pale, with a capillary refill time of five seconds.

After discussion with the National Poisons Information Service, topical infiltration with 1.5 mg of phentolamine mesilate in 1 ml of lignocaine (lidocaine) 2% was started with immediate response. Peripheral perfusion was restored in less than five minutes and the patient was discharged without sequelae.

In cases 1 and 3, the departmental protocol for needlestick injuries was followed.

## DISCUSSION

Accidental digital auto-injection of adrenaline from an EpiPen seems to be increasingly encountered in emergency departments worldwide. It is suggested that the incidence of accidental injection in the United Kingdom, is now 1 per 50 000 EpiPen units.<sup>3</sup> Recognising that this problem is increasing and is important because of the potential morbidity associated with the possible loss of a digit this review was undertaken to examine the published literature investigating this issue. Various methods have been tried to reverse the effect of adrenaline accidentally discharged into a digit. Systemic or topical nitroglycerin and warm water immersion have been attempted, but showed no significant improvement.<sup>4</sup> Topical infiltration with terbutaline was suggested in one case series, however further experience in the use of this drug seems to be needed.<sup>5</sup> Adrenaline can cause severe vasoconstriction because of its  $\alpha$  adrenergic effect, therefore the use of an  $\alpha$  adrenergic antagonist would seem appropriate.

Phentolamine, a short acting  $\alpha$  blocker used mainly to control blood pressure during surgical resection of pheochromocytoma, has been tried. Phentolamine digital block and intra-arterial administration have both proved beneficial in reversing the vasoconstrictive effect of epinephrine induced digital ischaemia, however, a further injection was frequently required to completely restore perfusion.<sup>6–9</sup> Local infiltration of phentolamine into the puncture site has been used and in most cases the ischaemia fully resolved within an hour.<sup>10–12</sup> Local infiltration of phentolamine is easier to perform and is still effective treatment up to 13 hours after the initial digital injection of adrenaline, which is useful if there is a delay in presentation.<sup>3</sup>

Spontaneous reversal of circulation after adrenaline induced ischaemia without long term sequelae has been reported clinically,<sup>9</sup> however most clinicians would be