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Gastric xenon trapping mimicking COPD: Recognition using an effervescent agent

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Abstract. Trapping of xenon 133 in the stomach due to gas swallowing can mimic xenon 133 retention in the left lower lobe due to obstructive lung disease on pulmonary ventilation/perfusion studies. In such cases, ingestion of sodium citrate-bicarbonate-simethicone crystals, which form CO_2 gas on contact with water, can distend the xenon-containing stomach and allow clear delineation of its gastric location. This approach is useful in selected cases and may help avoid false-positive diagnoses of obstructive airways disease.

Key words: Pulmonary embolism detection – V/Q scanning – Chronic obstructive lung disease

Perfusion imaging with ^{99m}Tc macroaggregated albumin is highly sensitive, but lacks specificity in the diagnosis of pulmonary embolism (DeNardo et al. 1984). The addition of ventilation studies with xenon and other gases, as well as comparison of perfusion scans with chest radiographs, has enhanced the ability of the test (V/Q scanning) to diagnose pulmonary embolism and differentiate it from obstructive lung disease (DeNardo et al. 1984; Biello et al. 1979).

Occasionally, V/Q studies can be confusing with residual ^{133}Xe activity seen in the left lower lung field region on delayed ventilation images. This activity occasionally is obviously located below the diaphragm and is due to ^{133}Xe ingestion with retention in the stomach. Frequently this activity leaves suddenly due to eructation, making it simple to tell that it was in the stomach. On other occasions, this ^{133}Xe activity does not leave promptly and can be confused with obstructive airways disease involving the left lower lobe. This is particularly problematic if the left hemidiaphragm is elevated or eventrated. Although comparison with a recent chest radiograph will often demonstrate this residual activity to be in the stomach, occasionally the findings are still somewhat confusing after comparison. To address this problem, we have instigated the use of sodium bicarbonate-citric acid-simethicone crystals, which liberate carbon dioxide gas when they contact water. These crystals are ingested by mouth and the CO_2 produced distends the ^{133}Xe-containing stomach, making it apparent that the ^{133}Xe is gastric in location.

Materials and methods

Ventilation scanning is performed in the posterior projection after the inhalation of 15–25 mCi (555–925 MBq) of ^{133}Xe. Gamma camera images are obtained during the wash in, equilibrium and wash out phases. Right and left posterior oblique views are obtained 3–5 min into the washout study. Ventilation images are examined before beginning the perfusion study. If a suspicion of ^{133}Xe retention in the stomach due to swallowing is present, the patient will generally be reimaged immediately after the ventilation study to detect loss of xenon due to eructation and occasionally in the left lateral or anterior projection to better delineate possible gastric anatomy. If eructation has not occurred and the additional views are not definitive after correlation with the chest radiographs, the patient is given 4 g of sodium bicarbonate-citric acid-simethicone crystals (E-Z gas) by mouth with 125 cc of water. Repeat images are then obtained. The perfusion scan is then performed using 3–4 mCi of ^{99m}Tc macroaggregated albumin. After intravenous injection in the supine position, posterior, right posterior oblique, left posterior oblique, anterior, right anterior oblique, left anterior oblique, right lateral and left lateral views are obtained at the 140 Kev window. Interpretation includes correlating the perfusion and ventilation scans with the chest radiographs using the interpretation scheme described by Biello et al. 1979.

Case report

A 34-year-old male presented with shortness of breath, pleuritic chest pain, and the clinical suspicion of pulmonary embolism. A ventilation study was performed that showed diminished wash in to both lung base regions and to a focal region of the right lateral lung field (Fig. 1a). On equilibrium images, some ventilation to the left lower lung field region was noted, but none to the right lower lung field (Fig. 1b). Washout images showed xenon retention in the left lower lung field up to 4 min (Fig. 1c). An anterior view of the chest 7 min into the study showed persistent left lower lung field region activity (Fig. 1d). The patient was then given E-Z gas crystals by mouth. A repeat image showed considerable enlargement of the left lower lung field focal activity, indicating it to be gastric in location (Fig. 1e).

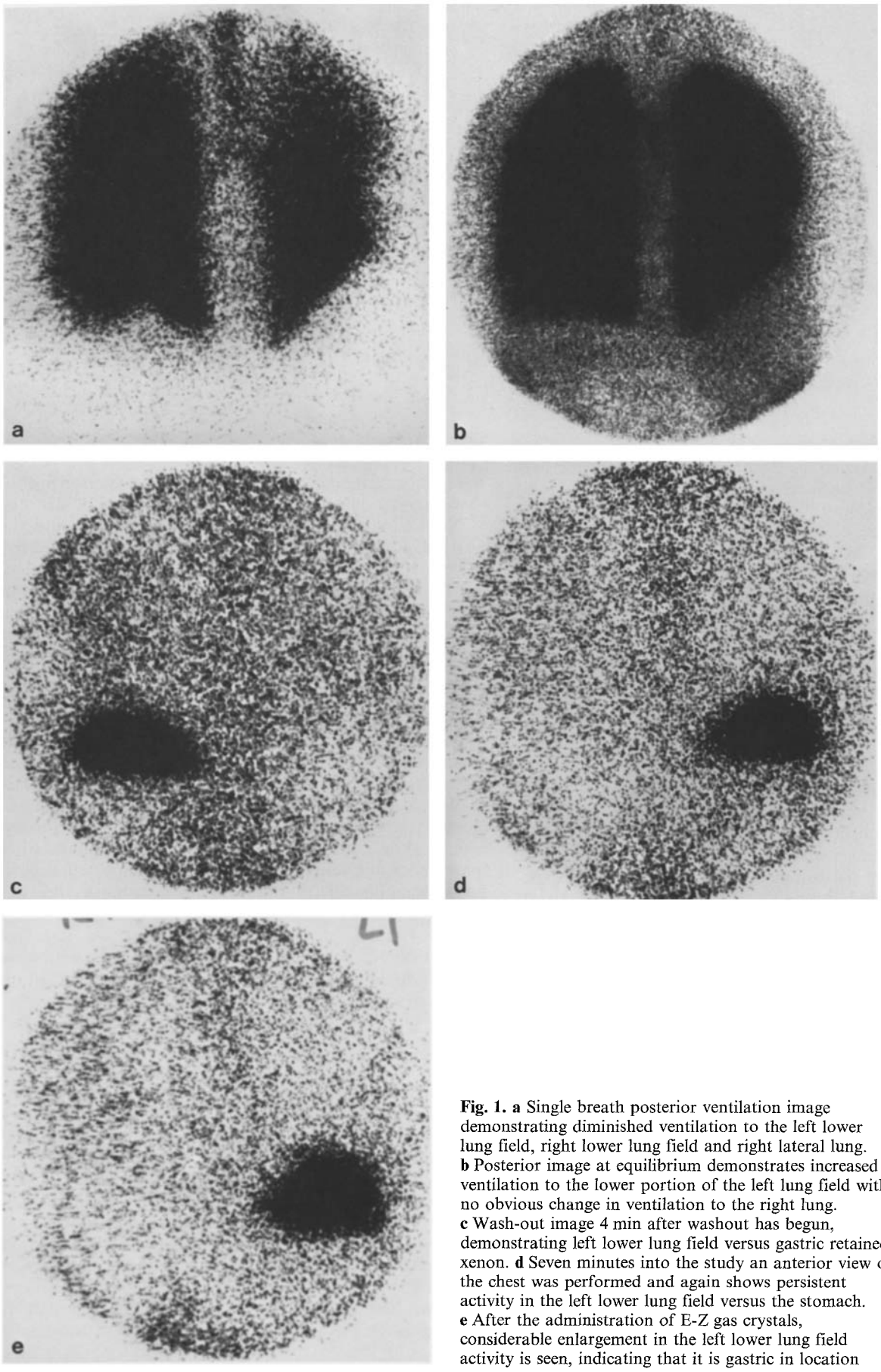

Fig. 1. a Single breath posterior ventilation image demonstrating diminished ventilation to the left lower lung field, right lower lung field and right lateral lung. **b** Posterior image at equilibrium demonstrates increased ventilation to the lower portion of the left lung field with no obvious change in ventilation to the right lung. **c** Wash-out image 4 min after washout has begun, demonstrating left lower lung field versus gastric retained xenon. **d** Seven minutes into the study an anterior view of the chest was performed and again shows persistent activity in the left lower lung field versus the stomach. **e** After the administration of E-Z gas crystals, considerable enlargement in the left lower lung field activity is seen, indicating that it is gastric in location

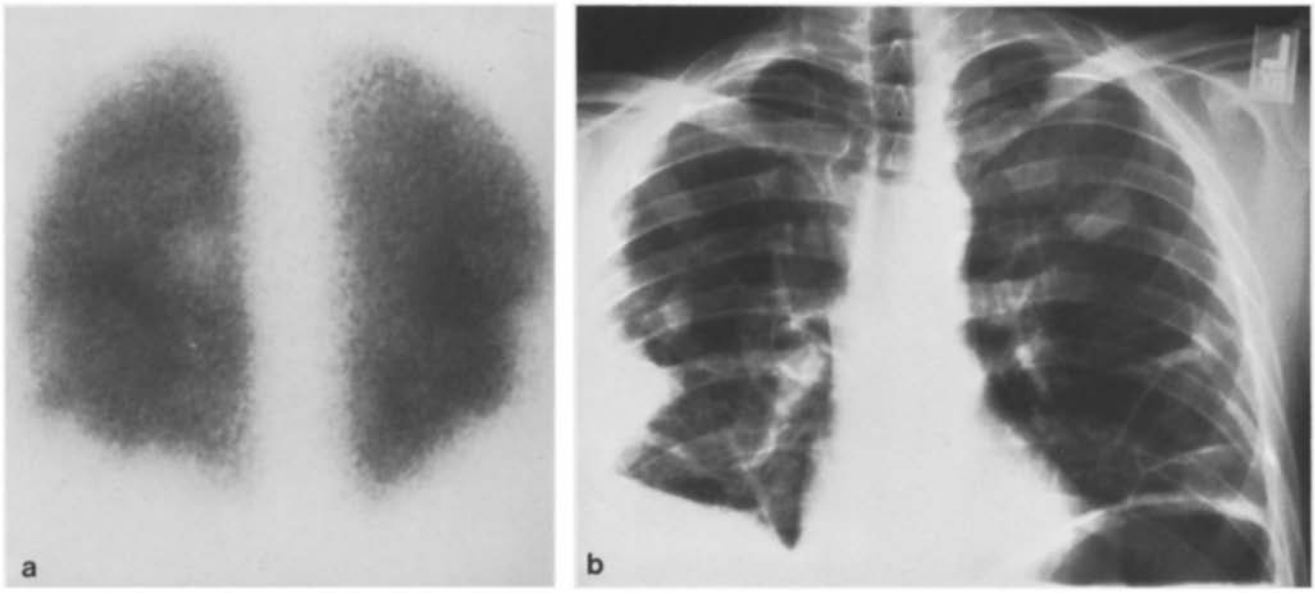

Fig. 2. a Posterior perfusion image demonstrating diminished perfusion to the left lower lung field which, in comparison to 1e, is in fact due to an elevated hemidiaphragm. In addition, diminished perfusion in the right lower lung field and laterally is seen. **b** Chest radiograph demonstrating elevated hemidiaphragm on the left with a prominent gastric air bubble corresponding the location of the stomach seen in 1d and e. Right lower lung field pleural effusion and pleural based density match the ventilatory and perfusion abnormalities, making this an intermediate probability scan

Perfusion images demonstrated abnormalities in the lower lung fields (Fig. 2a). A chest X-ray, which subsequently became available, demonstrated elevated left and right hemidiaphragms with a right pleural effusion and peripheral pulmonary infiltrate vs pleural lesion (Fig. 2b). The gastric air bubble was well seen and correlated in location with the xenon retention seen on ventilation study. Due to the matching pleural effusion and infiltrate and radiographic/ventilatory abnormality in the right lower lung field, this was interpreted as intermediate in probability. The patient was angiogramed with evidence of PE to the right lower lobe and has clinically improved.

Discussion

Swallowed xenon can be confused with xenon retention in the left lower lobe, particularly if the left hemidiaphragm is elevated or a focal eventration is present. Although in the case presented, the findings in the right lower lung field were sufficiently abnormal that the questionable ventilatory abnormality in the left lower lung field would not have altered the overall interpretation of the scan, in other instances the ventilation in the left lower lung field may be the key to the correct final diagnosis. Careful comparison with radiographs and an examination of delayed ventilation studies for evidence of sudden xenon loss due to eructation will often allow one to detect this occurrence. If this approach is unsuccessful, or if uncertainty remains regarding the location of this xenon activity, the simple administration of E-Z gas crystals will distend the stomach, enlarge the region of xenon activity if it is gastric in location, and on reimaging thus distinguish if the activity seen is gastric or pulmonary in location. This approach has been well tolerated (Wahl et al. 1984) and may be very useful when separating gastric and lung activity is difficult.

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