
Reverse Mismatched Ventilation-Perfusion Pulmonary Imaging with Accumulation of Technetium-99m-DTPA in a Mucous Plug in a Main Bronchus: A Case Report

Wei-Jen Shih and Benedek Bognar

Nuclear Medicine and Radiology Services, Veterans Administration Medical Center, Lexington, Kentucky and Department of Diagnostic Radiology, University of Kentucky Medical Center, Lexington, Kentucky

The phenomenon of reverse mismatched ventilation-perfusion on pulmonary scintigraphy is a fairly common occurrence. We present a patient who was experiencing decreasing oxygen saturation and had a reverse mismatched ventilation-perfusion imaging pattern associated with radio-tracer retention in a main bronchus. Technetium-99m-DTPA aerosol lung imaging showed tracer retention in the trachea and right main bronchus, absent ventilation in the right lung, and normal ventilation in the left lung. Technetium-99m-MAA perfusion lung images showed normal perfusion of the left lung and some perfusion in the right lung. These findings represented a reverse ventilation-perfusion mismatch. Reverse mismatched ventilation-perfusion, or totally absent ventilation with preservation of some perfusion in the right lung, resulted in functional intrapulmonary shunting, which explained the decreasing oxygen saturation observed in this patient.

A concurrent portable chest radiograph showed elevation of the right hemidiaphragm, a shift of the mediastinum to the right, deviation of the endotracheal tube, narrowing of the intercostal space of the right thorax, and collapse of the right lower lobe. The radiographic findings of underventilation of the right lung with atelectasis of the right lower lobe were due to mucous plugging the right main bronchus.

Key Words: pulmonary imaging; technetium-99m-DTPA; technetium-99m-MAA; reverse mismatched ventilation-perfusion

J Nucl Med Technol 1999; 27:303-305

A 19-year-old man was involved in a high-speed car accident. The vehicle collided with a telephone pole at a speed of 90 mph. He was partially ejected from the vehicle and the car came to rest on the patient's lower body. The patient lost consciousness at the scene, was extricated from beneath the automobile, intubated with an endotracheal tube at the scene, and transferred to the medical center. He received Lasix and mannitol en route. The diagnosis was status post-motor vehicle accident and

multiple trauma injuries with brain stem injury, right parietal-occipital subdural hematoma (closed head injury), C-7 and T-1 fractures, and gasoline burns to the buttocks.

CASE REPORT

The first chest radiograph of the patient after admission showed patchy opacity in the right lung, suggesting pulmonary contusion and a normally placed endotracheal tube (Fig. 1A). Twelve hours later the second chest radiograph showed an infiltration on the right lung with atelectasis of the right lower lobe and a small pneumothorax in the left lung (Fig. 1B). The left pneumothorax was treated by placing a chest tube and the pneumothorax resolved on the seventh hospital day.

A chest radiograph obtained 4 h before pulmonary scintigraphy (Fig. 2B) showed findings similar to those seen in Figure 2A, except for less apparent atelectasis of the right lower lobe. A concurrent portable chest radiograph (1 h before pulmonary scintigraphy) showed atelectasis of the right lower lobe, deviation of endotracheal tube to the right, elevation of the right hemidiaphragm, shifting of the mediastinum to the right, an overexpanded left lung, and an underexpanded right lung (Fig. 2A).

The patient was referred to nuclear medicine for a ventilation-perfusion lung imaging study because of decreasing O₂ saturation on the tenth hospital day. Technetium-99m-DTPA aerosol lung images showed tracer retention in the trachea and right main bronchus, absent ventilation in the right lung, and normal ventilation in the left lung (Fig. 3A). Subsequent ^{99m}Tc-MAA perfusion lung images showed normal perfusion of the left lung and some perfusion in the right lung. An area of radioactivity retention from ^{99m}Tc-DTPA aerosol corresponding to the right main bronchus indicated occlusion of the main bronchial lumen (Fig. 3B). There was no evidence of pulmonary embolism.

The occlusion of the right main bronchial lumen resulted in aberrant ventilation of the right lung. This was caused by a mucous plug. The mucous plug was resolved by suction after tracheostomy.

The next day the patient underwent C-7 to T-1 corpectomy with spinal fusion. Five days later, a tracheotomy was performed. A chest radiograph taken 10 d after the spinal fusion

For correspondence or reprints contact: Dr. Wei-Jen Shih, Nuclear Medicine Service, VA Medical Center, Lexington, KY 40511.

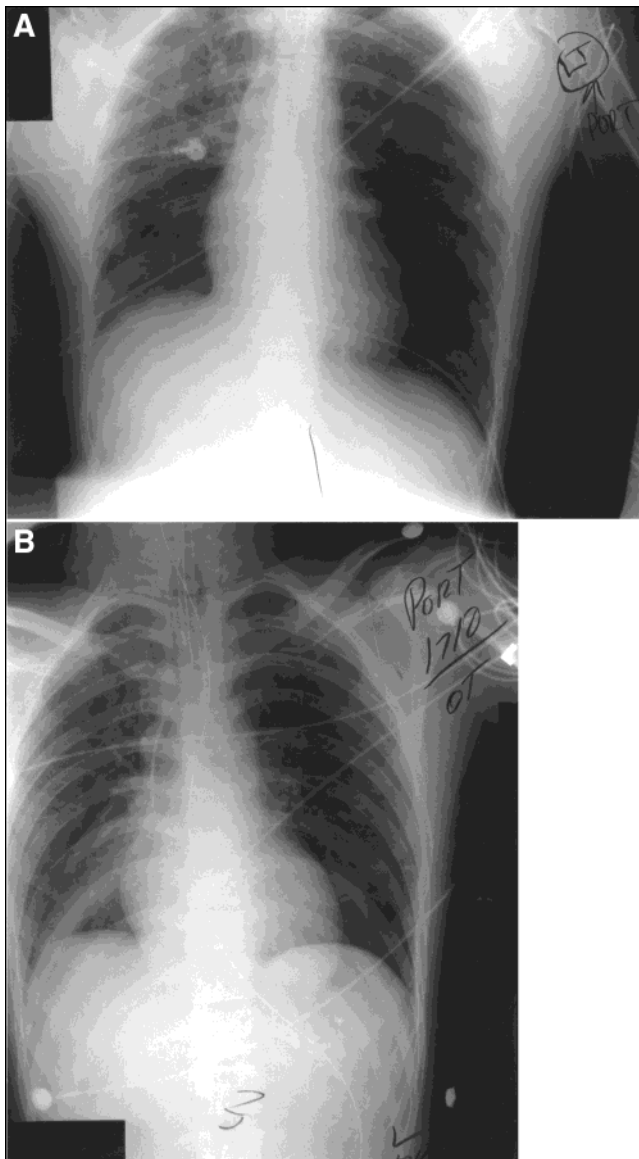


FIGURE 1. (A) The chest radiograph soon after admission shows a normally placed endotracheal tube and a patchy opacity in the right lung suggesting a pulmonary contusion. (B) The second chest radiograph obtained 12 h later shows an infiltration of the right lung with atelectasis of the right lower lobe and a small pneumothorax in the left lung.

showed the right lung was normally expanded. On the twenty-eighth hospital day this patient was transferred to another hospital for rehabilitation.

DISCUSSION

This young man's motor vehicle accident resulted in multiple traumatic injuries, including right lung atelectasis and a left pneumothorax. During the course of hospitalization, his chest radiographic findings changed within the span of a few hours. The traumatically injured lung and pleura appeared to be more vulnerable. The radiographic findings of underventilation of the right lung with atelectasis of the right lower lobe might be explained by mucous plugging the right main bronchus. Absent right lung ventilation was observed with ^{99m}Tc -DTPA aerosol

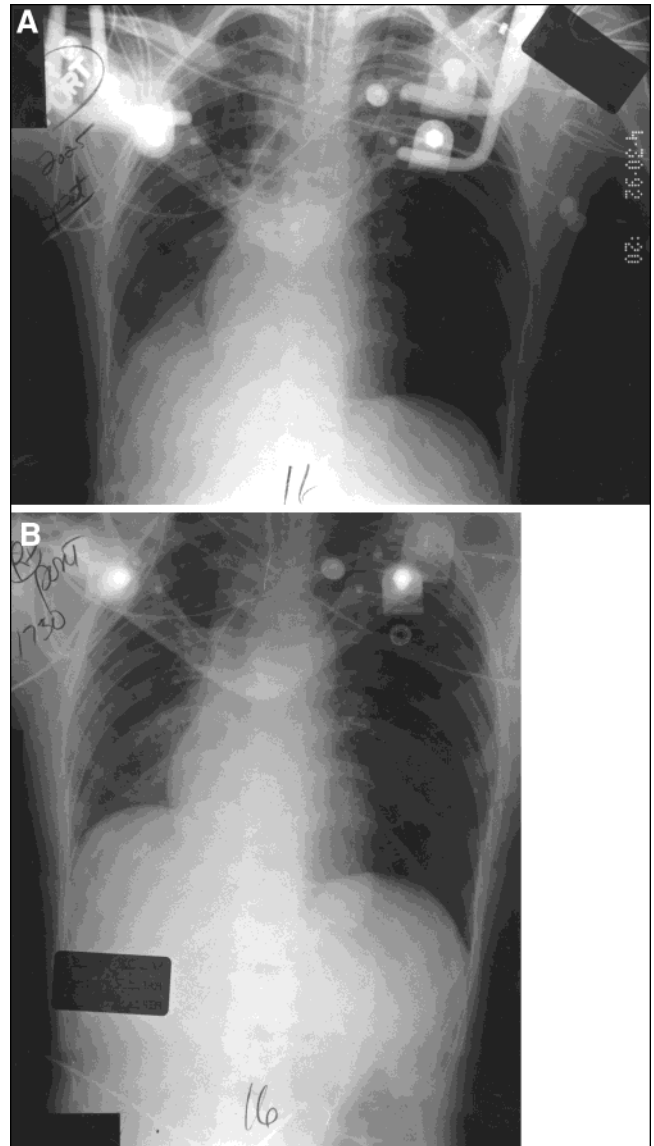


FIGURE 2. (A) A portable chest radiograph 1 h before pulmonary scintigraphy shows atelectasis of the right lower lobe, deviation of endotracheal tube to the right, elevation of the right hemidiaphragm, shifting the mediastinum to the right, an overexpanded left lung, and underexpanded right lung. (B) A chest radiograph obtained 4 h before pulmonary scintigraphy shows findings similar to those of Figure 2A except for less apparent atelectasis of the right lower lobe.

with accumulation of this radiotracer in the right main bronchus. A pattern of reverse mismatched ventilation-perfusion (totally absent ventilation with preservation of some perfusion in the right lung) led to functional intrapulmonary shunting, which explained the clinically decreasing oxygen saturation (1).

Positive pressure ventilation support has been reported to cause ventilation-perfusion reverse mismatch (2,3). In these cases there was still some ventilation of the diseased lung. This is different from this patient's totally absent ventilation of the right lung. In addition to bronchial obstruction and positive pressure ventilation support, reversed mismatched ventilation-perfusion has been reported in the following conditions: pulmonary hypertension (4), pulmonary infection (5), lung cancer (1,6-8), septic embolism (9), transient nitrofurantoin toxicity (10), tumor mass in the main bronchus (11), and

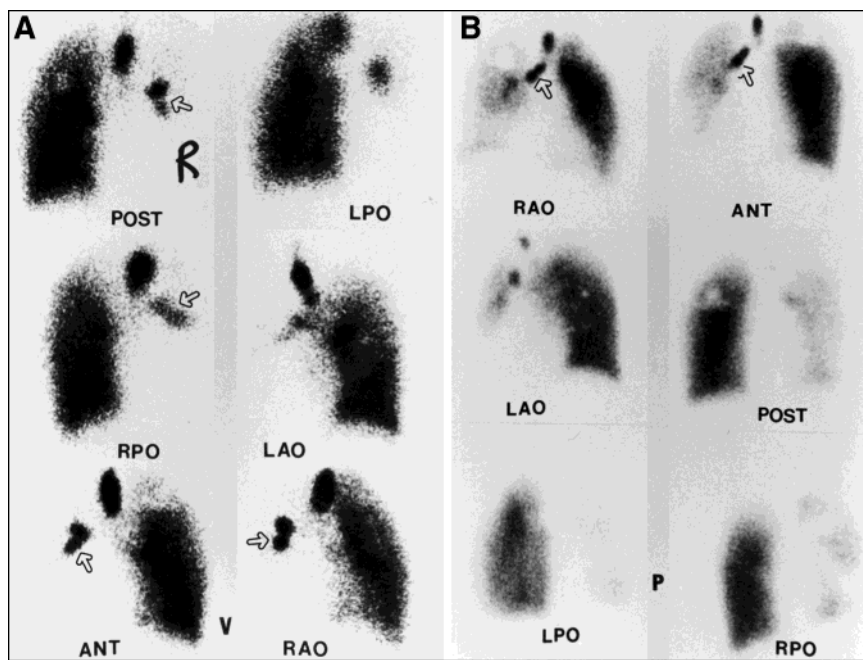


FIGURE 3. (A) Technetium-99m-DTPA aerosol lung images show tracer retention in the trachea and right main bronchus (open arrow), absent ventilation in the right lung, and normal ventilation in the left lung. An area of radioactivity retention from ^{99m}Tc-DTPA aerosol corresponding to the right main bronchus (open arrow) indicates occlusion of the main bronchial lumen. (B) Subsequent ^{99m}Tc-MAA perfusion lung images show normal perfusion of the left lung and some perfusion in the right lung. The open arrows identify the retained ^{99m}Tc-DTPA on the ^{99m}Tc-MAA images.

aspirated medication (12). This patient had a mucus plug in his right main bronchus that caused bronchial obstruction.

CONCLUSION

The imaging finding of a reverse mismatched ventilation-perfusion pattern on a lung scintigraphy is a fairly common occurrence. This patient's reverse mismatched ventilation-perfusion finding was associated with radiotracer (^{99m}Tc-DTPA) retention in 1 main bronchus and absence of ventilation to the corresponding lung.

Radiotracer (^{99m}Tc-DTPA) retention in a mucus plug in a main bronchus may be observed only with ^{99m}Tc-DTPA aerosol lung imaging. Technetium-99m-MAA would not accumulate in a bronchial mucus plug because MAA would not come into contact with the mucus plug because it is administered intravenously as a perfusion tracer. Xenon-133 is a gaseous ventilation tracer and has never been reported to accumulate in mucus plugs.

REFERENCES

1. Wartski M, Zerbib E, Regnard J-F, Herve P. Reverse ventilation-perfusion mismatch in lung cancer suggests intrapulmonary functional shunting. *J Nucl Med.* 1998;39:1986-1989.
2. Kim CK, Heyman S. Ventilation/perfusion mismatch caused by positive pressure ventilatory support. *J Nucl Med.* 1989;30:1268-1270.
3. Hawker FH, Torzillo PJ, Southee AE. PEEP and "reverse mismatch:" a case where less PEEP is best. *Chest.* 1991;99:1034-1036.
4. Engeler CE, Kuni CC, Tashjian JH, et al. Regional alterations in lung ventilation in end-stage primary pulmonary hypertension: correlation between CT and scintigraphy. *AJR.* 1995;164:831-835.
5. Li DJ, Stewart I, Miles KA, et al. Scintigraphic appearances in patients with pulmonary infection and lung scintigrams of intermediate or low probability for pulmonary embolism. *Clin Nucl Med.* 1994;19:1091-1093.
6. Watanabe N, Hirano T, Inoe T, et al. Transient unilateral reverse ventilation/perfusion mismatch in a patient with lung cancer. *Clin Nucl Med.* 1992;17:705-708.
7. Chetty KG, Dick C, McGovern J, et al. Refractory hypoxemia due to intrapulmonary shunting associated with bronchioloalveolar carcinoma. *Chest.* 1997;111:1120-1121.
8. Shih WJ, Dillon ML. Matched ventilation-perfusion becomes mismatched ventilation-perfusion lung imaging after resolution of carcinoma of the bronchus. *Clin Nucl Med.* 1994;19:279-286.
9. Spencer RP. Ventilation/perfusion reverse mismatch in septic pulmonary emboli. *Clin Nucl Med.* 1996;21:328-329.
10. Basoglu T, Erkan L, Canbaz F, et al. Transient reverse ventilation-perfusion mismatch in acute pulmonary nitrofurantoin reaction. *Ann Nucl Med.* 1997;11:271-274.
11. Shih WJ, Johnston EH, Johnston HW. Reversed abnormal ventilation-perfusion scintigraphy in endobronchial squamous cell carcinoma. *Eur J Nucl Med.* 1982;7:523-525.
12. Slavin J, Sherigar R, Spencer RP. Ventilation-perfusion "reverse mismatch" from aspirated medication. *Clin Nucl Med.* 1998;23:719-720.