Clinical Ventilation Imaging with In-113m Aerosol: A Comparison with Kr-81m

F. Fazio, P. Wollmer, J. P. Lavender, and M. M. Barr

Hammersmith Hospital, London, UK and Istituto S. Raffaele, Milano, Italy

Following routine ventilation (Kr-81m)/perfusion (Tc-99m) scanning, we obtained aerosol ventilation scans using a solution of In-113m albumin and a settling-bag system. The large-volume settling bag reduces deposition of particles in the large airway by removing large droplets. The patient inhales the aerosol with 5–10 min of tidal breathing, then lung scans are obtained on a gamma camera. The energy of In-113m allows the ventilation scanning to be performed after Tc-99m perfusion scanning. Semiquantitative scoring of regional ventilation showed a close correlation (r = 0.97) between Kr-81m and In-113m aerosol ventilation scans. The aerosol technique gave a slight underestimation of ventilation compared with Kr-81m. This is explained by a slightly reduced penetration of particles to the periphery of the lung in patients with severe obstructive airways disease. In all cases, however, the aerosol did visualize all ventilated regions. The results indicate that this readily available aerosol technique can be useful for clinical ventilation imaging in multiple views.

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In the past fifteen years, a number of different techniques involving inhalation of radioaerosol and subsequent recording with planiscanners of gamma cameras have been proposed as diagnostic procedures for assessing regional ventilation (*1–8*). With most of these methods the main limitation is the significant central deposition of aerosol that occurs in patients with chronic airflow obstruction, preventing the ventilation image from being directly compared with that of perfusion. Since central deposition of aerosol increases with increasing particle size, effort has been concentrated in generating particles of small size. A particularly promising approach in this respect is a concept recently developed (*7,9*), whereby the larger particles of a polydispersed aerosol are removed by a settling bag in the line between the nebulizer and the patient. We have modified this technique in order to minimize particle size and to allow the ventilation study to be performed immediately after a Tc-99m perfusion scan. The gamma emitter is the highly energetic In-113m (393 keV).

The aim of this paper is to evaluate the limitations and the potential usefulness of the technique by comparing it with reference ventilation scanning obtained by continuous inhalation of Kr-81m.

METHODS

Aerosol generation system. The technique is derived from that proposed by Hayes et al. (*9*), the main differences being that a larger settling bag (50 l instead of 3) was used and In-113m albumin solution was nebulized instead of a compound labeled with Tc-99m. The In-113m albumin solution was prepared as follows: Indium-113m (393 keV, $T_{1/2}$ = 99.5 min) was eluted from a generator containing Sn-113 ($T_{1/2}$ = 115 days). Four milliliters of the eluate were mixed with 0.25 ml 1% human serum albumin solution, and 0.75 ml of 0.2 *N* NaOH and 1.0 ml of 0.1 *M* phosphate buffer were added. The solution was nebulized by a disposable plastic nebulizer* utilizing compressed air at a flow rate of 8 l/min. The aerosol was collected in a 50-l settling bag

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For reprints contact: F. Fazio, MD, Cattedra di Medicina Nucleare dell'Università, Istituto S. Raffaele, Via Olgettina 60, 20132 Milano, Italy.

placed in the delivery line between the nebulizer and the patient's mouthpiece (Fig. 1). Near the end of the nebulization the subject was connected to the mouthpiece, breathing room air. As soon as the bag was filled with In-113m albumin suspension, the nebulizer was stopped and the patient switched over to the bag, from which he inhaled the aerosol by tidal breathing for 5–10 min until the bag was empty. A filter† was placed in the expiratory line to trap exhaled particles.

The sizes of the particles generated by the nebulizer and of the particles delivered from the settling bag were measured with a cascade impactor‡ (*10*). Six samples were obtained from the outlet of the nebulizer during nebulization. Six samples were also obtained from the mouthpiece during six *ad hoc* inhalations from the settling bag. These collections were the same as in patient studies in all details but for the sampling of particles.

Subjects. Thirty-six subjects were studied: nine normal volunteers (five smokers and four nonsmokers) and 27 patients. The latter were all referred to the scanning unit for routine Kr-81m ventilation and Tc-99m perfusion scanning and were selected on clinical grounds in order to provide a wide spectrum of conditions in which ventilation-perfusion imaging is performed on the clinical suspicion of pulmonary embolism. In particular, patients with various degrees of obstructive airways disease were needed, since the presence of airways obstruction may limit the use of aerosol ventilation techniques. Details of the patients are shown in Table 1. Informed written consent was obtained for the addition of the aerosol study to the routine scanning procedure. The group of patients encompasses a variety of pulmonary diseases, including pulmonary embolism, chronic obstructive airways disease, and mixed vascular and parenchymal disease (Table 1). Diagnoses were those established by the clinicians at the time of hospital discharge and included, when indicated and available, pulmonary angiography and follow-up lung scans. In all patients a careful clinical history, standard posteroanterior and lateral radiographs, and pulmonary function tests—including vital capacity (VC) and forced expiratory volume in one second ($FEV_{1.0}$)—were obtained within 2 hr of the scintigraphic study.

Scintigraphic techniques. Routine ventilation (Kr-81m)/perfusion (Tc-99m) scans were first performed in six views as previously described (*11,12*). In five of the normal volunteers, only Kr-81m ventilation scans were performed. For each scan, at least 300,000 counts were collected on a large-field gamma camera equipped with either a high-resolution or a high-energy collimator. After the routine examination, the patient was taken to an adjacent room for the aerosol inhalation procedure, and immediately after the end of the inhalation was taken back to the gamma camera. Here In-113m aerosol scans were obtained, usually in four views: anterior, posterior, and right and left posterior obliques (anterior obliques were added if necessary), using a high-energy collimator and setting the analyzer window for the 393 keV peak of In-113m.

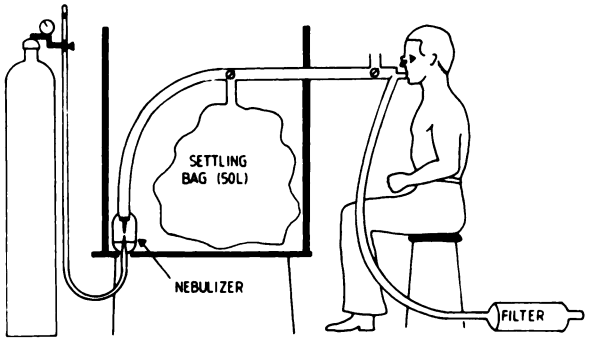

FIG. 1. Aerosol delivery system. The isotope solution is nebulized into a 50-l settling bag. Following nebulization, the patient inhales the aerosol from the bag. A filter is placed in the expiratory line.

All scintigraphic data were both recorded on photographic film and stored in a dedicated computer.

Quantitative comparison of Kr-81m and In-113m ventilation scans. Comparisons of these ventilation scans were carried out in two ways. The ability of the aerosol technique to outline the ventilated regions of the lung was assessed using a modification of a semiquantitative technique proposed by Secker-Walker et al. (*12,13*). The ventilation pattern of the Kr-81m ventilation scan was compared with the deposition pattern seen in the aerosol ventilation scan. In each of the anterior and posterior analog images, the lung was divided into an upper and lower zone, and the pattern in each zone was scored from 0 to 4 in the following way. For Kr-81m: 0 = no ventilation, 1 = markedly reduced, 2 = moderately reduced, 3 = slightly reduced ventilation, and 4 = normal. For In-113m aerosol: 0 = no peripheral distribution of activity, with or without central foci of increased activity, 1 = markedly reduced peripheral distribution, but possible to identify an outline, 2 = moderately reduced peripheral distribution, 3 = central focal areas of increased activity with normal or slightly reduced peripheral distribution, 4 = uniform distribution of aerosol. The scores for each region were then added and the total score expressed as a percentage of 32, the score for normal lungs.

A second comparison involved quantitative assessment of the penetration of the aerosol into the lungs (*14,15*) and its relation to overall lung function.

Two regions of interest were selected on the Kr-81m computer images within each lung: one over the larger bronchi, comprising approximately 20% of total lung field, and one over the periphery of the lung, comprising approximately 50% of total lung field (Fig. 2). The ratios of the mean counts/cell in the peripheral region to the mean counts/cell in the hilar region was termed the penetration index (PI). The PI for the Kr-81m scans (PI ^{81m}Kr) was then calculated as the average PI from the anterior and the posterior scans for both lungs. Identical

TABLE 1. CHARACTERISTICS OF NORMAL SUBJECTS AND PATIENTS

Subject	Sex	Age	Smoking status*	VC (% pred.)	FEV_1 (% pred.)	PI_{Kr}	PI_{In}	Clinical diagnosis†
RC	M	39	S (25)	98	100	0.637	0.638	Normal subject
DT	F	37	S (20)	98	119	0.625	0.609	Normal subject
SR	M	32	S (22)	115	110	0.688	0.651	Normal subject
PW	M	26	N	104	118	0.696	0.684	Normal subject
JB	M	25	S (2)	112	102	0.577	0.487	Normal subject
TM	M	19	N	96	107	0.593	0.489	Normal subject
BA	M	30	N	119	122	0.619	0.620	Normal subject
CT	M	26	N	102	96	0.661	0.553	Normal subject
JO	M	50	S (21)	102	100	0.509	0.524	Normal subject
AL	M	19	S (1)	56	51	0.738	0.638	Pneumonia
TL	M	61	S (15)	100	83	0.672	0.650	Chronic PE
WB	M	59	S (30)	71	12	0.576	0.294	CB, E
DJ	F	40	N	52	61	0.711	0.619	Recurrent pneumothorax
JY	M	41	S (15)	84	76	0.754	0.625	Bilateral basal atelectasis
HG	M	76	X (40)	49	32	0.814	0.381	CB, LVF
WL	M	66	X (41)	69	21	0.772	0.437	CB, E
RB	M	54	X (8)	48	41	0.645	0.507	PE
UK	F	73	S (60)	89	94	0.817	0.676	PE, CB, pneumonia
GH	M	76	X (12)	100	83	0.720	0.621	Pulmonary infarction
KJ	M	66	S (50)	115	81	0.719	0.641	CB
JC	M	64	S (50)	71	29	0.632	0.518	CB
GW	M	47	S (21)	72	76	0.629	0.485	PE
FY	M	60	X (9)	94	82	0.557	0.564	PE
JP	M	65	S (50)	69	27	0.589	0.264	CB
JH	M	44	X (8)	57	55	0.727	0.415	Acute bronchitis, LVF
HB	M	81	X (30)	74	36	0.616	0.352	CB, PE
AD	M	66	X (4)	97	47	0.636	0.413	BA
MM	F	48	X (23)	78	48	0.768	0.429	PE, BA
PW	F	53	N	45	22	0.584	0.376	Obliterative bronchiolitis
MS	M	39	X (12)	91	87	0.586	0.513	LVF
MS	F	71	X (1)	94	102	0.530	0.536	Bullous emphysema
JT	M	76	X (12)	68	24	0.498	0.270	PE, CB, E
DF	F	33	N	58	53	0.611	0.586	Systemic lupus erythematosus
ME	F	57	N	76	91	0.686	0.650	PE, LVF
VH	F	69	X (11)	54	50	0.643	0.513	PE
CC	F	56	N	50	43	0.691	0.503	BA

* N = nonsmoker, S = current smoker, X = ex-smoker. Number in parentheses denotes pack years.

† PE = pulmonary embolism, CB = chronic bronchitis, E = emphysema, BA = bronchial asthma, LVF = left ventricular failure.

regions of interest were selected on the In-113m scans and a PI ^{113m}In calculated in the same way. In each subject the penetration of the aerosol was then normalized to the penetration of the gas by taking the ratio of the two penetration indices (PI ^{113m}In/PI ^{81m}Kr).

RESULTS

The results of the particle-size measurements are shown in Fig. 3.

The nebulizer produced a polydispersed aerosol with particles ranging from less than 1 to over 10 μm in size, and only 25% of the activity was represented by particles smaller than 2 μm. The range is significantly reduced by the settling bag, with the result that about 85% of the activity inhaled by the patient is represented by particles smaller than 2 μm and virtually no particles are larger than 4 μm. For every millicurie of In-113m nebulized, approximately 240 cps were obtained by the camera, corresponding to 0.2 mCi deposited in the lung, as estimated by comparison (in two subjects) with perfusion scanning obtained following i.v. injection of known amounts of In-113m-labeled human albumin microspheres. This results in an absorbed radiation dose of 150 mrad to the lungs (target organ).

All subjects, including patients with severe airways

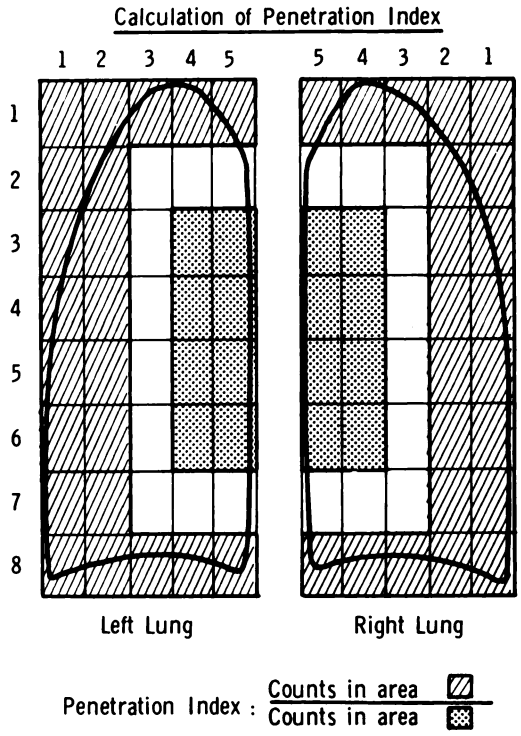

FIG. 2. Quantitative assessment of aerosol penetration into lung periphery (penetration index). Two fixed regions of interest are chosen in each lung. Ratio between mean counts/cell in peripheral area (comprising approximately 50% of total lung field) and mean counts/cell in hilar area (comprising approximately 20% of total lung field) defines penetration index for each tracer.

obstruction, could perform the inhalation of aerosol without discomfort. Scans obtained in the posterior and right posterior oblique views of a normal subject are shown in Fig. 4. These show a uniform, peripheral distribution of the particles to the lungs, and are virtually superimposable on the Kr-81m scans.

The patients in the present study were referred to the scanning unit either on suspicion of pulmonary embolism or for a functional assessment of lung disease. In most cases, clinical information and the routinely performed Kr-81m/Tc-99m $\dot{V}/\dot{Q}$ scan provided the basis for management.

All patients with a final clinical diagnosis of acute pulmonary embolism had $\dot{V}/\dot{Q}$ mismatch. This was seen in all cases using both Kr-81m and In-113m aerosol for ventilation scanning. All patients with a diagnosis of acute pulmonary embolism were treated with anticoagulants. All patients but one (JT, who had severe coexisting obstructive airways disease) responded well to the treatment.

Case reports. As examples of aerosol scan appearance in disease, the following cases are presented.

Case 1 (*pulmonary embolism*). A 60-yr-old man had a 2-wk history of tenderness in the left calf following minor injury. On the day before examination, he had two episodes of chest pain associated with shortness of breath, each lasting about 30 min. Chest radiograph showed clear lung fields. The perfusion scan (Fig. 5) showed segmental perfusion defects in both lungs, whereas regional ventilation showed a normal distribution both by the In-113m aerosol and the Kr-81m ventilation. Pulmonary embolism was diagnosed. The patient was treated with anticoagulants and showed complete clinical remission.

Case 2 (*chronic bronchitis*). A 66-yr-old smoker, with a history of chronic bronchitis, complained of recent onset of diffuse pain in the left leg accompanied by sudden increase in shortness of breath. The chest radiograph showed clear lung fields and the perfusion scan showed multiple defects in both lungs. In this case, however, the defects were clearly matched by similar ventilation defects detectable both on the In-113m aerosol and on the Kr-81m scan, thus indicating low probability of pulmonary embolism (Fig. 6). The In-113m aerosol images are remarkably similar to those obtained with Kr-81m, with good peripheral penetration and lack of central particle deposition.

Case 3 (*pulmonary embolism, chronic bronchitis, pneumonia*). A 73-yr-old lady, a heavy smoker with a history of chronic bronchitis, was admitted to hospital because of pyrexia and shortness of breath. Ten days before admission, she had an episode of chest pain, pleuritic in nature, and during the following week she became febrile and started to produce purulent sputum. On admission, the chest radiograph showed an area of consolidation in the right lung (Fig. 7). The perfusion scan showed multiple defects, considerably larger in size than the radiological shadowing. Both the Kr-81m ventilation and the In-113m aerosol scans showed a well-defined defect of ventilation corresponding to the radiographic changes, and, in addition, other ill-defined, nonsegmental areas of reduced ventilation in both lungs. Nevertheless, ventilation was not grossly impaired in most of the underperfused zones with normal radiographic appearance. In order to establish a firm diagnosis, a pulmonary angiogram was obtained, which showed intravascular emboli on the right side (arrow)

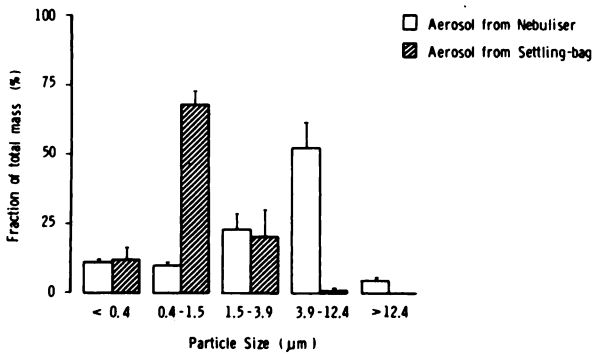

FIG. 3. Measurements of aerosol particle size. Abscissa: stages of cascade impactor corresponding to different size groups. Ordinate: fraction of particle mass present in each stage. Settling bag acts as a filter removing particles of larger size.

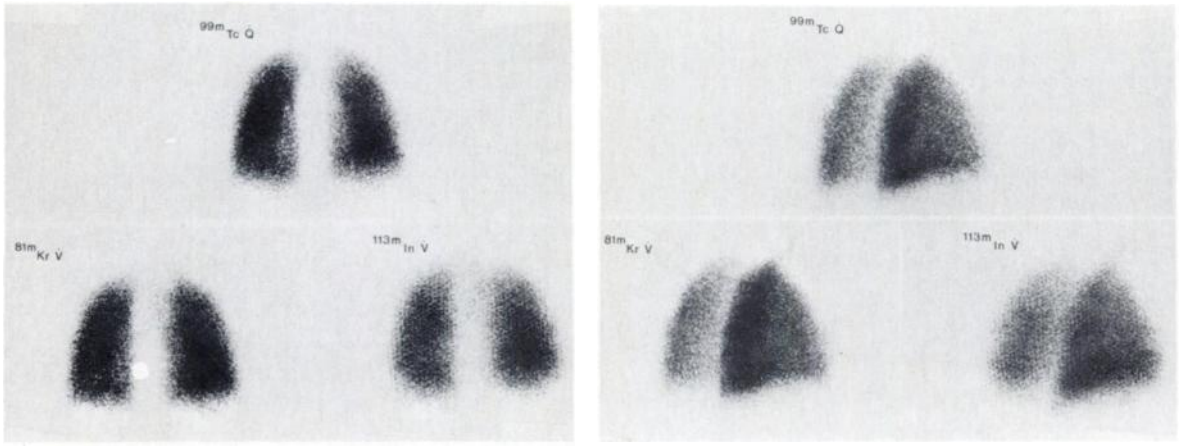

FIG. 4. Tc-99m perfusion, Kr-81m ventilation, and In-113m aerosol scans of normal subject in posterior (left) and right posterior oblique (right) views, showing peripheral distribution of aerosol and close correspondence of Kr-81m to In-113m scans.

plus peripheral inhomogeneities, thus confirming the scintigraphic diagnosis of mixed parenchymal and embolic disease. The consolidation visible on the chest radiograph, diagnosed as pneumonia, gave better definition by Kr-81m than by the In-113m aerosol, likely because of collimator penetration by the highly energetic gamma of In-113m.

Case 4 (*severe chronic obstructive airways disease*). A 66-yr-old man was a heavy smoker who was severely disabled by chronic obstructive airways disease. He was referred to the scanning unit for regional lung-function assessment. He had a low $FEV_{1.0}$ and VC (21% and 69% of predicted values) and increased residual volume (226% of predicted value). The chest radiograph showed large-volume lungs and flat diaphragms as well as reduction of vascular markings in the lung fields. In both lungs the perfusion scan showed widespread, diffuse perfusion defects that were matched by similar ventilation defects on both the Kr-81m and the In-113m ventilation scan (Fig. 8). In this case of severe chronic airways obstruction there was some difference between the Kr-81m ventilation and the In-113m aerosol scan: the latter showed some focal areas of increased activity in the hilar lung regions due to central particle deposition. There was, however, sufficient penetration of the aerosol to the lung periphery to outline the ventilated regions, best shown if the upper threshold in the computer image of the In-113m scan is reduced to the same level as that of the Kr-81m image.

Quantitative comparison of Kr-81m and In-113m aerosol ventilation scans. Results of the semiquantitative scoring of regional ventilation with the two techniques demonstrated a close correlation between the two assessments of ventilation ($r = 0.97$, $p < 0.001$). The aerosol technique shows a systematic tendency to underestimate regional ventilation when compared with Kr-81m, but the differences are small. In no individual region was the score for the aerosol 0 (absent ventilation) when it was >0 for Kr-81m.

The discrepancy between the two techniques for ventilation scanning is further illustrated in Fig. 9, which shows for the entire group of patients the relation of the

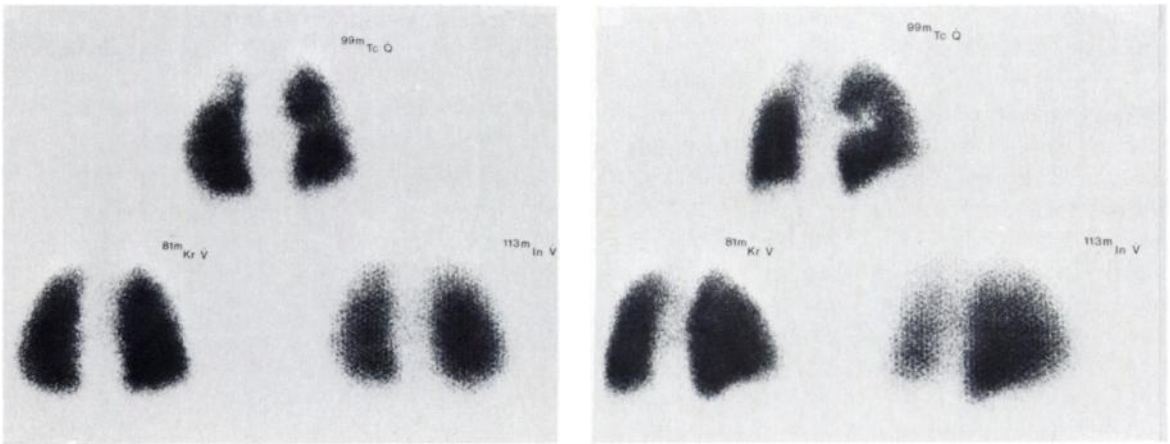

FIG. 5. Case 1. Pulmonary embolism. Tc-99m perfusion, Kr-81m ventilation, and In-113m aerosol scans in posterior (left) and right posterior oblique views (right). Segmental perfusion defects are associated with normal distribution of ventilation as assessed both with Kr-81m and In-113m aerosol.

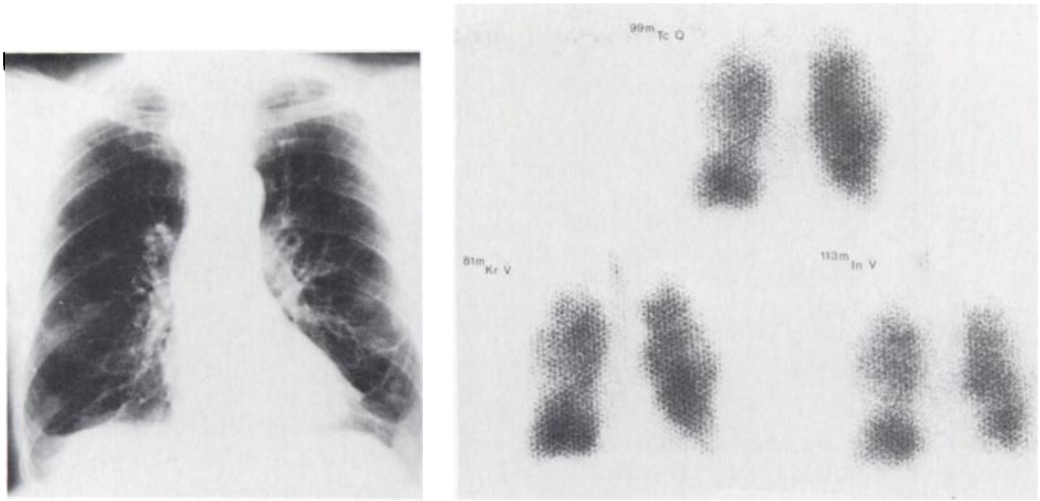

FIG. 6. Case 2. Chronic bronchitis. Chest radiograph (left) and Tc-99m perfusion, Kr-81m ventilation, and In-113m aerosol scans in right posterior oblique views (right). Perfusion defects are matched by similar ventilation defects on both Kr-81m and In-113m scans. Note close resemblance between Kr-81m ventilation and In-113m ventilation scans and absence of central particle deposition.

normalized penetration index to the $FEV_{1.0}$, taken as an index of airways obstruction. Normal subjects, and patients with mild to moderate airways obstruction, showed high values of penetration index, indicating good penetration of the aerosol into the lungs. Patients with severe airflow obstruction had lower penetration indices, indicating a more central aerosol deposition. However, the ratio of the penetration index value never falls below 0.5, indicating that, even in extremely severe airways obstruction, there is detectable passage of particles to the lung periphery.

DISCUSSION

Pulmonary perfusion scintigraphy using Tc-99m-labeled microspheres is a very sensitive technique for the detection of pulmonary embolism (*16*), but, since regional pulmonary perfusion is impaired in many disorders, including airways disease, its specificity is low. There are indications that the specificity is increased by the addition of a ventilation scan, especially in cases with multiple segmental or subsegmental perfusion defects (*17*,*18*); but whereas the technique for perfusion scanning is now widely accepted and standardized, a number of different methods are still used for ventilation scanning. Ideally, a ventilation scan should be obtained in multiple views immediately after an abnormal perfusion scan. The Xe-133 single-breath:washout study (*19*) is still the most commonly used technique, but it suffers from a number of disadvantages (*12*). Generally, images are obtained in one view only, even though the use of multiple views has been described (*20*). The images obtained are not directly comparable with the perfusion

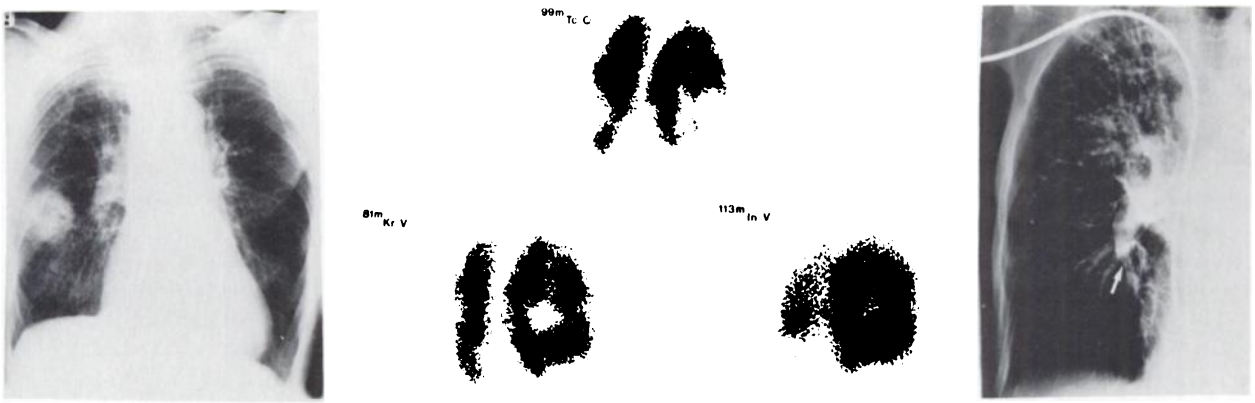

FIG. 7. Case 3. Pulmonary embolism, chronic bronchitis, pneumonia. Chest radiograph (left), scintigrams (center), and contrast angiogram (right). Tc-99m perfusion, Kr-81m ventilation, and In-113m aerosol scans are in right posterior oblique views. Chest radiograph shows area of consolidation in right lung. Tc-99m perfusion shows marked underperfusion to consolidated area as well as to areas with normal radiographic appearance. Both Kr-81m and In-113m aerosol scans show that regional ventilation, although abnormal, is still present in most underperfused areas, indicating mixed disease. Collimator penetration results in lower resolution with In-113m relative to Kr-81m in area of decreased activity due to consolidation. Diagnosis of mixed disease [pulmonary embolism (arrow) and parenchymal lung disease] was subsequently confirmed by angiography (right), which shows intravascular emboli on right side (arrow) and peripheral inhomogeneities.

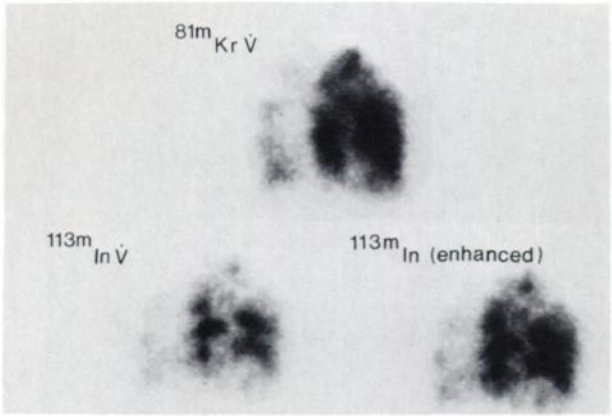

FIG. 8. Case 4. Severe chronic obstructive airways disease. Computer images of Kr-81m ventilation (top) and In-113m aerosol (lower left) scans in right posterior oblique view. Central deposition of aerosol gives rise to focal areas of increased activity with high count density in In-113m scan. If threshold in latter is adjusted to make maximum count density equal to that in Kr-81m scan, satisfactory delineation of ventilated area is obtained (lower right).

images, owing to the difference in energy between the two tracers and the unphysiological inhalation pattern. Furthermore, ventilation scanning has to be performed before the perfusion study, which is not in keeping with the diagnostic strategy of pulmonary embolism.

The use of Xe-127 (*21*) allows the ventilation scan to be performed following the perfusion study, and the view to be chosen as the one best demonstrating a perfusion defect. However, Xe-127 is expensive and its availability is limited, since a high-energy linear accelerator is required for its production.

Continuous inhalation of Kr-81m (*11*) is a steady-state technique that yields images of high statistical quality in multiple views, and it can be performed at the same time as the Tc-99m perfusion scan. While qualitatively satisfactory, this technique has the disadvantage of a rather limited availability, due to the short shelf life ($T_{1/2}$ = 4.6 hr) of the cyclotron-produced Rb-81 → Kr-81m generator. Although these generators are now being produced commercially both in Europe and in the United States, it is difficult to have Kr-81m available on a daily basis.

Like continuous inhalation of Kr-81m, radioactive aerosols represent a steady-state approach to ventilation scanning. By using aerosol it is possible to obtain ventilation scans in multiple views, and, if a suitable emitter energy is chosen, to perform the study immediately after the perfusion scan. The use of aerosols for ventilation scanning has been hampered by difficulties in finding a simple way of generating particles in a suitable size range. The particle should be smaller than about 2 μ in order to deposit by sedimentation in the peripheral airways (*22,23*) and reflect regional ventilation. Larger particles deposit mainly by impaction in the larger airways and give rise to central focal areas of increased uptake on the scan. An important achievement in this field was the development of the settling-bag technique by Hayes et al. (*9*). The bag removes the larger particles from a polydisperse aerosol and thereby reduces particle size to a range more suitable for ventilation scanning. The aim of the present study has been to evaluate a modification of the original settling-bag technique by comparing it with the other steady-state technique for ventilation scanning, continuous inhalation of Kr-81m.

We chose to use a larger settling bag in order to ease the performance of the study and to minimize the possibility of particles bypassing the settling bag during the inhalation. We also used In-113m, which has an energy (393 keV) that can easily be distinguished from that of Tc-99m, allowing the aerosol study to be performed after the perfusion scan. Indium-113m is easily obtained from a generator made of its long-lived parent Sn-113 ($T_{1/2}$ = 115 days) and thus can be available at all times. (Sn-113 → In-13m generators are available from several producers in Europe, but have not yet been approved for clinical use in the United States.) The inhalation procedure, which is very simple and generally completed within about 10 min, can be performed in a room separate from that of the gamma camera in order to minimize camera time and background radiation.

The limitations of the present aerosol techniques are related to the energy of the tracer used and to the physical properties of the aerosol. The high energy of In-113m means that the resolution in the aerosol ventilation scan is lower than that in the Kr-81m and Tc-99m scans (Fig. 7). The prominent cross talk between the two lungs also prevent straight lateral views from being obtained with the aerosol scan. In the present series, however, we did not see any localized defects in the Kr-81m scans that

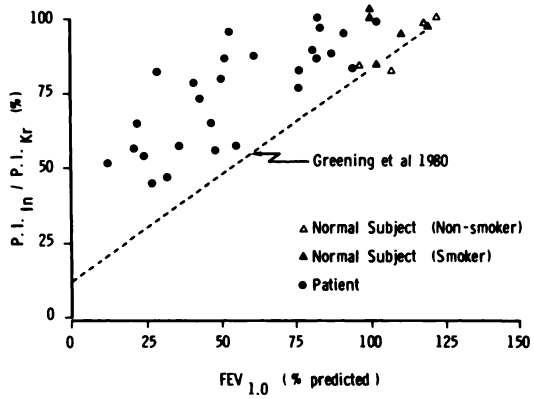

FIG. 9. Relation of normalized penetration index for In-113m aerosol (ordinate) to $FEV_{1.0}$, taken as index of airways obstruction (abscissa). Penetration of particles is reduced, but not to a great extent, in patients with severe airflow obstruction. Solid dots = patients, solid triangles = normal subjects (smokers), and open triangles = normal subjects (nonsmokers). Dashed line is regression line from Greening et al. (*15*).

were not clearly detectable also by In-113m aerosol. This is also shown by the semiquantitative scoring of the scans; in no case was the In-113m aerosol scored as normal if the Kr-81m was abnormal.

In normal subjects, inhaled particles of the size obtained from the settling bag deposited by sedimentation in the periphery of the lung, and the aerosol ventilation scans obtained are qualitatively very similar to the Kr-81m ventilation scans. In patients with severe airways obstruction (Case 4), there was some central deposition of particles. This caused a slight underestimate of regional ventilation, but in no case was ventilation erroneously judged as being absent. The analysis of penetration index confirms that the penetration of aerosol is reduced in patients with airways obstruction, and shows the reduced penetration to be related to the degree of airways obstruction as measured by FEV_1. This suggests an increased particle deposition by impaction in the narrowed and distorted airways in obstructed patients.

Using the same method for calculating the penetration index, we recently reported a linear relation between $FEV_{1.0}$ and the penetration of presized albumin minimicrospheres directly nebulized with a Venturi-type nebulizer (*15*). As shown in Fig. 9, the penetration of the In-113m aerosol as nebulized with the settling-bag technique is significantly more peripheral, particularly in obstructed patients, than that of the presized particles directly nebulized—this despite the fact that in the study with the presized particles the penetration index was measured from delayed views taken 3 hr after the nebulization, when some of the aerosol deposited in the main bronchi had already cleared.

A comparison between radioaerosol from an air-jet nebulizer without settling bag and Xe-133 single-breath/washout study has been carried out by Shibel et al. (*24*). They found deposition of aerosol in the trachea, mainstem bronchi, and stomach in normal subjects. In patients with obstructive airways disease, they reported heavy deposition in proximal airways, and peripheral zones containing little or no particles, although they were ventilated as judged from the Xe-133 study. In the present study only insignificant activity was found in the mouth, stomach, and trachea in a few subjects. In all our patients with severe airflow obstruction, there was penetration of the aerosol to the periphery of the lung (Case 4, Fig. 8), and the outlines of the ventilated regions could be clearly identified. The differing results of the two studies are likely to be due to the different sizes of the particles inhaled. The favorable comparison between Kr-81m ventilation and In-113m aerosol scan indicates that the In-113m settling-bag technique is an alternative to Kr-81m for obtaining ventilation images in multiple views, complementary to Tc-99m perfusion scans.

Accordingly, controlled comparison with pulmonary angiography seems warranted in order to assess specificity of the Tc-99m-perfusion-In-113m aerosol technique for the diagnosis of pulmonary embolism.

FOOTNOTES

* OEM Medical Inc., Richmond, VA.
† Microflow LF 40, Microflow Pathfinder Ltd., Fleet, UK.
‡ Casella MK 2A, CF Casella & Co. Ltd., London, UK.

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New England Chapter—Technologist Section
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10th Annual Spring Symposium

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The tenth annual Spring Symposium will be held April 16 and 17, 1982 at the Sheraton Regal Inn in Hyannis, Massachusetts.

The meeting will include an all day cardiac workshop and discussion on Saturday.

Technologist and student presentations on various topics will be given on Friday and Saturday.

Guest lecturers will include: Harvey J. Berger, MD, Ronald Callahan, PhD, Alexander Gottschalk, MD, Richard Spencer, MD, H. William Strauss, MD, Frans Th. Wackers, MD, and Robert W. Zimmerman, MSEE.

For further information contact: Linda M. Pytlik, Yale New Haven Hospital, Nuclear Medicine Dept. CB-3, 789 Howard Ave., New Haven, CT 06504.

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23rd Annual Meeting

October 27-30, 1982 **Radisson Plaza Hotel and Civic Center** **Charlotte, North Carolina**

Announcement and Call for Abstracts

The Scientific Program Committee of the 23rd Annual Meeting of the Southeastern Chapter of the Society of Nuclear Medicine, chaired by R. Edward Coleman, M.D., is requesting the submission of original contributions in nuclear medicine from members and nonmembers of the Society.

The program will be approved by the Subcommittee on Continuing Education and Course Accreditation of the Society of Nuclear Medicine as one which meets the criteria for AMA Category 1 credit.

Physicians and scientists are encouraged to submit abstracts, as are technologists. Accepted technologist papers will be presented on the Scientific Program and will be eligible for awards.

Abstracts must be prepared in final form for direct photoreproduction on the official abstract form. For abstract forms and additional information, contact:

Robert H. Rohrer, Ph.D
Administrative Director SEC/SNM
Department of Physics
Emory University
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Deadline for submission of abstracts: July 1, 1982.