THE PULMONARY CAPILLARY BED AFTER LYMPHOGRAPHY

W. H. SMITH AND C. A. PARSONS

SUMMARY
A small series of patients underwent radio-isotope lung scanning before and after the bipedal injection of oily contrast medium for abdominal lymphography to assess known malignant disease. After lymphography the lung scans showed an increase of between 12 and 100% in the radioactivity recorded over the anterior chest. No change was recorded over the posterior aspect of the chest. It is suggested that the increase is a result of blockage of posteriorly placed pulmonary capillaries and diversion of blood flow to the anterior segments.

An awareness of the complications which may occur during and after lymphography (Kinmonth, 1972) would allow steps to be taken to minimize their effect. This paper relates to the complication of pulmonary oil embolism following the injection of contrast medium into the lymphatics of the feet.

Even if a very small volume (less than 4 ml) is injected, some of the oil reaches the lungs. Gold and colleagues (1965) calculated that if 20 ml of Lipiodol was broken up into micro-emboli, 10 \( \mu \)m in diameter, it would be possible for every capillary in the average lung to receive two such emboli. They found that the pulmonary diffusing capacity, capillary blood volume and pulmonary compliance were all reduced for 72 h after lymphography. Wallace (1967) performed lymphograms on patients before thoracotomy. Lung biopsies, taken almost immediately after lymphography, showed fat staining material almost exclusively in capillaries. In biopsy specimens taken 24 h after the injection there was oil still in the capillaries. In addition, fat staining material was located in the interstitial tissues. In the alveolar spaces and bronchi there was phagocytosis of oil by macrophages. Also, following the use of \( ^{131} \)I-labelled Ethiodol as the lymphographic contrast medium, radioactive \( ^{131} \)I was demonstrated in the patients' sputum.

The authors have undertaken lymphography in a number of hospitals and find that the importance of oil embolism and depressed respiratory function following the procedure may be overlooked. The present study was undertaken to provide a demonstration of the effect of lymphography on the pulmonary capillary bed.

MATERIALS AND METHODS
Five patients who required abdominal lymphography for the assessment of malignant disease gave their informed consent to lung scanning 24 h before and 6 h after the procedure. In addition, two patients were investigated, because a pulmonary infarct was suspected, and were found to have normal scans. These acted as controls and agreed to a second scan 24 h after the first.

In each patient the technique was identical for both scans. Care was taken to give exactly the same dose of radioactive isotope, about 1.5 mCi of Tc\(^{99m}\), attached to the same volume of albumen macroaggregate on each occasion. The distribution of the isotope in the lung fields was recorded by a rectilinear scanner calibrated, on each occasion, to produce the same amount of film blackening per unit of radioactivity detected.

The diameter of the macroaggregate particles is 10-60 \( \mu \)m; thus the isotope distribution identifies the position of labelled particles wedged in capillaries of approximately this diameter.

RESULTS
All the patients had normal lung scans initially. The control patients had unchanged scans 24 h later. On the second scan four of the other five patients showed a significant increase in the amount of activity detected anteriorly over the chest (fig. 1A and B). No patient had a significant change in the amount of radioactivity distributed to the posterior segments of the lungs. The number of radioactive disintegrations per second over the "hottest" part of the chest anteriorly and posteriorly on the two scans is shown in tables I and II. There were increases of 12, 25, 37 and 100% in the level of activity anteriorly.
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TABLE I. Anterior radioactive “counts” per second

<table>
<thead>
<tr>
<th>Before lymphogram</th>
<th>After lymphogram</th>
</tr>
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<tbody>
<tr>
<td>100 000</td>
<td>200 000</td>
</tr>
<tr>
<td>80 000</td>
<td>110 000</td>
</tr>
<tr>
<td>80 000</td>
<td>100 000</td>
</tr>
<tr>
<td>125 000</td>
<td>140 000</td>
</tr>
<tr>
<td>60 000</td>
<td>60 000</td>
</tr>
</tbody>
</table>

TABLE II. Posterior radioactive “counts” per second

<table>
<thead>
<tr>
<th>Before lymphogram</th>
<th>After lymphogram</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 000</td>
<td>70 000</td>
</tr>
<tr>
<td>50 000</td>
<td>50 000</td>
</tr>
<tr>
<td>60 000</td>
<td>60 000</td>
</tr>
<tr>
<td>75 000</td>
<td>60 000</td>
</tr>
<tr>
<td>30 000</td>
<td>25 000</td>
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</table>

Fig. 1. Anterior lung scans of the same patient (a) (top) before lymphography and (b) (bottom) 6 h after lymphography.

A review of the patient who showed no change in the post-lymphogram lung scan revealed that he had received an insufficient dose of contrast medium to allow satisfactory demonstration of the abdominal nodes.

DISCUSSION

No radioactivity detectable by the method used remains in the lungs at 24 h after a lung scan.

The oily contrast medium passes through the lymphatic channels and nodes to the left subclavian vein. This occurs at a slow constant rate over the duration of the injection, about 1.5 h. The fine droplets are distributed in the pulmonary arterial blood.

This study indicates that in the supine position there is preferential occlusion of posteriorly directed lung capillaries by the oil droplets, resulting in the diversion of blood to the anterior pulmonary segments.

At the time of the post-lymphography lung scan some isotope-labelled albumen particles enter the terminally occluded, and temporarily stagnant, posteriorly directed capillaries. Because of this posterior capillary occlusion there is a preferential flow of blood to the anterior segments, carrying with it a higher proportion of the injected isotope.

The radiologist has a dilemma; he must inject enough oil to produce a satisfactory lymphogram without giving an unnecessarily large dose to the lungs. Usually, control x-rays are taken to show the progress of the column of contrast medium and the injection is stopped when the level of the fourth lumbar vertebral body is reached. If the lymphogram is of good quality there will be a degree of pulmonary oil embolism. The consequent decrease in function is more important if there is pre-existing lung disease.

Enlargement of the abdominal lymph nodes will not prevent some of the oil reaching the lungs. Obstruction of the lymphatics will cause a delay in the upward passage of contrast medium and in the occurrence of decreased pulmonary function.

REFERENCES


**LE LIT CAPILLAIRE PULMONAIRE APRÈS LYMPHOGRAPHIE**

**RESUME**

Un petit nombre de patients a été soumis à une analyse des poumons par des isotopes radio-actifs avant et après l'injection bipédale d'un agent huileux opacifiant pour lymphographie de l'abdomen, afin d'évaluer toute maladie maligne connue. Après la lymphographie, les analyses des poumons ont montré une augmentation allant de 12% à 100% de la radioactivité enregistrée sur la poitrine antérieure. On n'a enregistré aucun changement de l'aspect postérieur de la poitrine. Il est suggéré dans cet article que cette augmentation résulte d'un blocage des capillaires pulmonaires placés postérieurement et de la diversion du débit sanguin sur les segments antérieurs.

**DIE LUNGENKAPILLARGEFÄSSE NACH LYMPHOGRAPHIE**

**ZUSAMMENFASSUNG**


**EL LECHO CAPILAR PULMONAR TRAS LINFOGRAFÍA**

**SUMARIO**

Una serie reducida de pacientes fue sometida a gammagrafía pulmonar antes y después de la inyección bipérdica de un contraste aceitoso para linfografía abdominal, para evaluar una malignopatía detectada. Tras la linfografía el barrido gammagráfico pulmonar mostró un aumento de entre 12% y 100% en la radiactividad registrada sobre la sección antero-torácica. No se registró cambio alguno sobre el aspecto posterior del tórax. Se sugiere que el aumento es resultado de bloqueo de los capilares situados posteriormente en el campo pulmonar, y de una desviación del flujo hemático a los segmentos anteriores.
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