

# Dynamic Leg Scintigraphy with an LFOV Scintillation Camera

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*Leg scanning is now routinely performed in most laboratories in conjunction with lung perfusion studies since thrombi arising in the deep veins of the lower extremities are a major cause of pulmonary emboli. However, dynamic leg scintigraphy, i.e., visualization of venous blood flow in the lower extremities, has not been practical because the area observed by the detectors of earlier model scintillation cameras was unsatisfactory. The more advanced large field-of-view scintillation camera with a synchronized scanning table simplifies the performance of dynamic leg scintigraphy. Our experience with such an instrument is described.*

Blood flow in man has been investigated by a variety of methods in recent years. Wagner and Jones developed the particle distribution method to measure regional blood flow in the extremities (1, 2). The venous circulation of the lower extremity was first studied by Wright in 1948 using radioactive sodium, Na-24; the average flow time was  $18 \pm 0.9$  sec and the extreme range of the observations was 4-50 sec (3). Fabrikant and his associates, using I-131 Diodrast, made the method clinically applicable in determining the extent of deep vein involvement (4). Tow and Wagner studied venous insufficiency in patients with lower extremity thrombophlebitis using Tc-99m-labeled albumin (5).

Each year a significant number of deaths are attributed to pulmonary emboli. Since the major cause of pulmonary embolization is usually venous thrombosis, it is essential that every possible means be used to obtain information in this regard (6). Blood flow studies of the legs undertaken by these and other investigators (7-10) form the basis of current methods for detection of thrombi in the lower extremities.

## Materials and Methods

Our instrumentation consisted of a Searle LFOV scintillation camera, a micro-dot imager, and a synchronized scanning table. A high-sensitivity parallel hole collimator was used routinely for the dynamic and static venography.

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## Instrument Parameters

We used the following instrument parameters:

*Analyzer control*—the isotope pushbutton to detect the 140-keV energy of technetium-99m is depressed;

*Mode select*—only the “static” pushbutton should be depressed;

*Camera mode*—depress the scan pushbutton;

*Detector orientation*—switch to “above table”;

*Display field length*—switch to “100”;

*Scan format*—set “width” to 30;

*Limits*—“start” limit is set to 5; “stop” limit is set to 104;

*Table speed*—12 cm/min; and

*Photometer sens control*—600-low.

## Materials and Techniques

The following materials were used: two 10-ml syringes filled with normal saline; two 23-gage scalp-vein infusion sets; two three-way stopcocks; and two doses of Tc-99m HAM (1.5-2.0 mCi per dose) in appropriate syringes.

The patient is placed on the scanning table in the *supine* position with his feet at the head of the table and

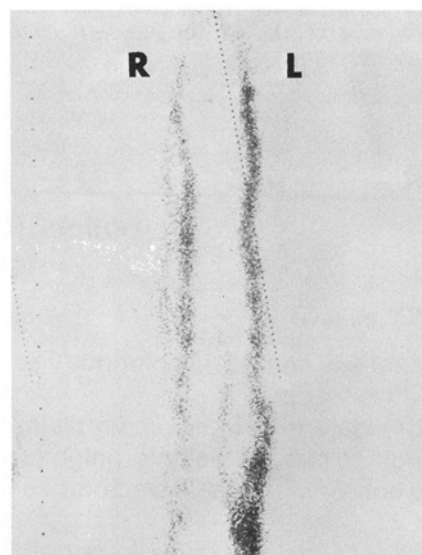
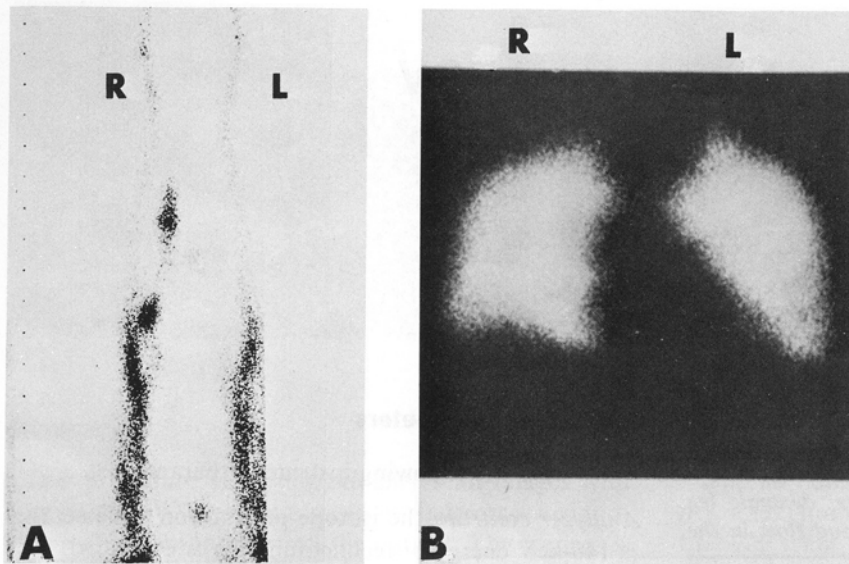


FIG. 1. Normal bilateral venous flow (anterior view).



**FIG. 2.** (A) Venogram flow (anterior view): disease of right internal saphenous; (B) Perfusion study: multiple areas of diffuse decrease in perfusion. Normal venogram.

the detector positioned above him. The display orientation pushbutton located adjacent to the patient's feet is depressed to orient the images properly. Absorbent paper is placed beneath the feet to prevent the scanning table from becoming contaminated.

Radioactive markers are placed on the table to mark the ankles, knees, mid thighs, and hips. Tourniquets are tightened above the ankles and 23-gauge scalp-vein needles with attached stopcocks are inserted into the dorsal pedal veins of both feet. Flush the infusion sets after venipuncture with some saline to clear blood from the tubing and to insure that extravasation has not occurred.

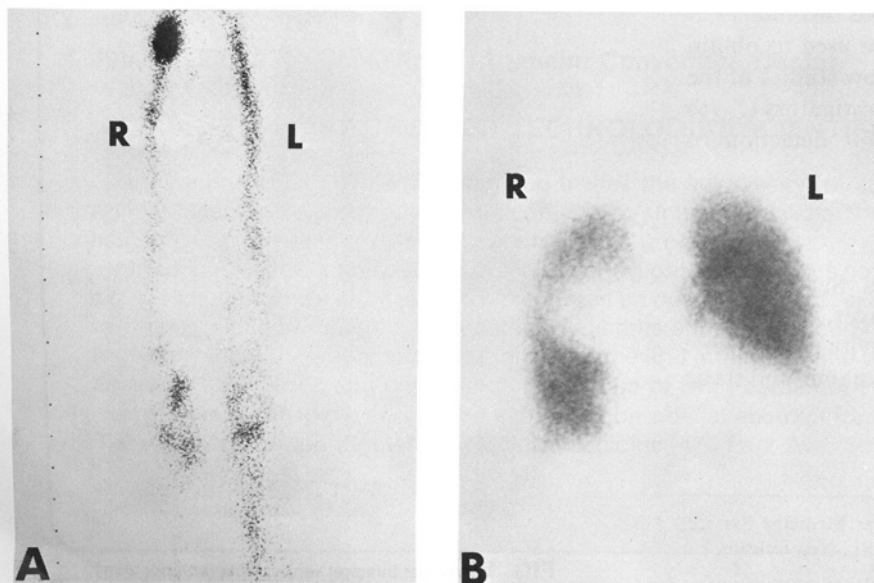
Obtain and administer the doses of Tc-99m HAM. Flush the dose immediately with the remainder of the saline. Leave tourniquets in place to drive the tracer into the deep venous system. Press the *start* button on the

camera console and, as soon as the scanning table indexes, set the scanning table speed to 128 cm/min. After completing the leg flow study, obtain appropriate views of the lungs, followed by the static venography study.

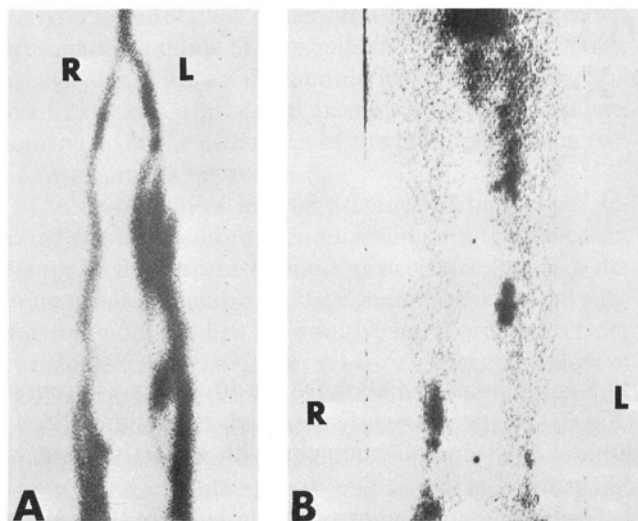
### Discussion

Radionuclide venography, in both the dynamic and static modes, and lung perfusion studies were performed on 25 patients with suspected pulmonary embolism and thrombophlebitis. Normal bilateral venous flow is demonstrated (Fig. 1).

In 12% of the cases, where only the dynamic venogram was abnormal, the findings indicated decreased blood flow or occlusion of the lower extremities. Interestingly, 24% of the patients were observed to have abnormal dynamic venography and lung perfusion studies with no



**FIG. 3.** (A) Venogram flow (anterior view) shows partial obstruction of right calf and abnormality in groin; (B) Perfusion study shows gross defect in anterior segment of right lobe. Normal venogram.



**FIG. 4.** (A) Venogram flow (anterior view): extensive collateral circulation bilaterally; (B) Venogram: extensive localization in left femoral, popliteal veins, right distal calf, and proximal femoral veins. Normal perfusion study.

evidence of thrombophlebitis apparent on static venograms (Figs. 2 and 3). In all cases where there was evidence of venous thrombosis on the static venogram, the dynamic venography study was also abnormal (Fig. 4). All data obtained in this study are displayed (Table 1).

**TABLE 1. Radionuclide Venography—Perfusion Studies**

Dynamic Venogram	Static Venogram	Perfusion	No. of Patients	Percent of Patients
N	N	N	2	8
N	N	Ab	5	20
Ab	Ab	Ab	7	28
Ab	N	N	3	12
Ab	Ab	N	2	8
Ab	N	Ab	6	24

N indicates normal; Ab indicates abnormal.

## Conclusion

A large field-of-view scintillation camera with a synchronized scanning table is very useful for performing dynamic leg scintigraphy. Blood flow scans of the deep veins of the lower extremities contribute essential information in the detection of deep vein thrombophlebitis. Abnormalities such as decreased blood flow and obstruction in the lower extremities may not be observed when only the delayed venogram is performed. Our studies indicate that it is practical and useful to perform blood flow studies routinely, along with the static venogram and perfusion study, whenever either pulmonary embolism or thrombophlebitis, or both, are suspected.

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