

## Blood Flow Visualization With the Scintillation Camera

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The scintillation camera offers a simple method of visualizing the flow of blood through vessels and organs (1). The method has been used to demonstrate blood flow in the brain, carotid arteries, heart, pulmonary vessels, lungs, liver, kidneys, and abdominal aorta. The camera views the organ or other structure in question. A large amount of short half-life radioisotope is injected rapidly into an antecubital vein. Cardiopulmonary dilution of the bolus is insufficient to prevent adequate visualization of the areas listed. A series of five second exposures on Polaroid film and one second exposures on 16-mm motion picture film are made simultaneously. The test requires but a few minutes, and there is no hazard nor discomfort to the patient, such as those associated with aortography. Examples of blood flow scintiphotos of two areas are presented.

### METHOD

Technetium-99m pertechnetate is prepared from a molybdenum-99 cow (2). The conventional dose is 10 millicuries administered in a 5 to 15 cc volume of normal saline solution. Potassium thiocyanate or perchlorate may be used to block thyroid uptake of pertechnetate ion. The pulse height discrimination of the scintillation camera is set for 0.125 to 0.155 MeV, and a thin-septum multi-channel collimator is used.

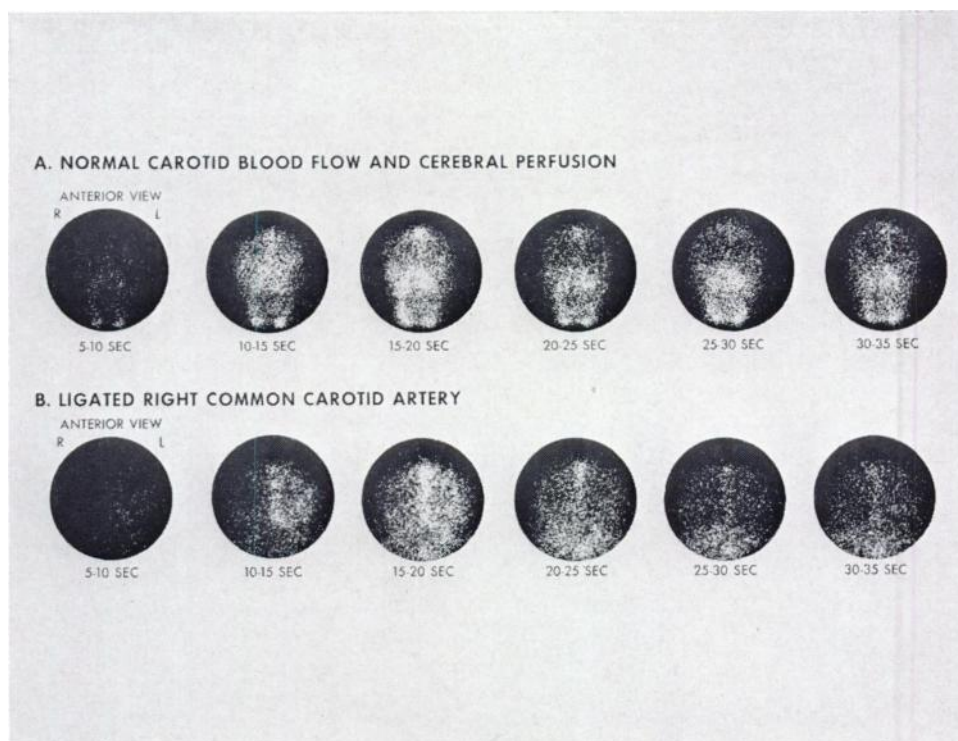
Cerebral blood flow is imaged with the camera viewing the anterior aspect of the head. For renal blood flow, the camera views the posterior aspect of the kidneys. The patient is positioned prone with a pillow under the abdomen to reduce the lumbar lordosis. Camera placement is checked by prior scintiphotos of a 100 microcurie dose of <sup>203</sup>Hg chlormerodrin. Accurate positioning is important because the scintillation camera field of view is 10 inches in diameter.

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The arm used for injection is positioned to minimize restriction of venous return. Rapid injection of a bolus of 10 millicuries of technetium-99m pertechnetate is accomplished through a No. 20 needle. The camera is switched on five seconds after injection, and the Polaroid roll film is pulled out manually, one frame every five seconds with the Polaroid camera shutter open continuously. A series of eight five-second exposures is obtained ending 45 seconds after injection of the bolus. The room is semidarkened during the procedure to avoid fogging the Polaroid film by exposure to bright light during its seven second period of photosensitivity. Simultaneous one frame per second movies are taken with a 16 mm movie camera.

Examples. Figure 1A shows normal carotid blood flow and cerebral perfusion. Figure 1B is a similar study in a patient with a ligated right common carotid artery. A decrease of initial blood flow is clearly observed on the right, as well as perfusion of the right side of the brain from the left in later pictures. Over-all perfusion of the right side of the brain appears less than the left. Figure 2A shows normal abdominal aortic blood flow and renal perfusion. Figure 2B is a similar study in a subject with a large left renal cyst. The cyst outline is readily identified in the lateral margin of the left kidney as a dark area which completely lacks perfusion by technetium-99m pertechnetate. Some of the other anatomy that can be identified in these pictures includes widening of the aorta at the inter-renal level, narrowing of the aorta proximal to the aortic bifurcation, the bifurcation, suggestions of renal arteries, and the renal outlines.

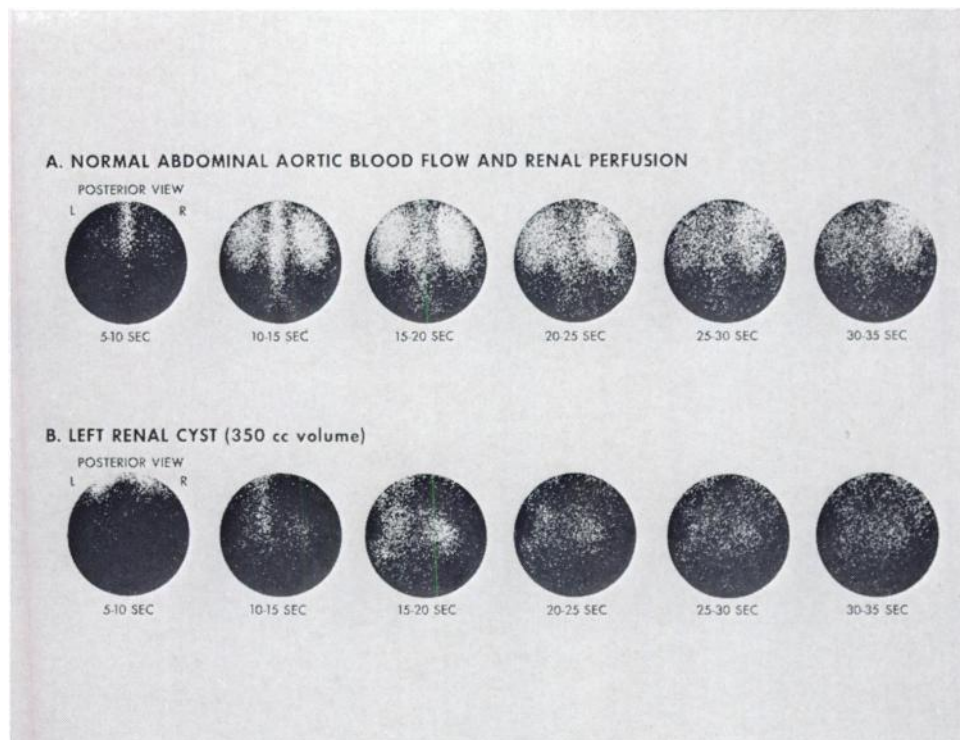


**Figs. 1A and 1B**

## DISCUSSION

Visualization of technetium-99m pertechnetate after peripheral venous injection offers a rapid and safe estimate of blood flow and tissue perfusion. Brain and kidney studies are presented as examples of areas wherein this test is expected to be of particular importance. The conventional indirect methods of estimating renal blood flow are fraught with difficulties of interpretation, in addition to their expense. Direct visualization of renal blood flow by x-ray angiography is an exacting procedure which has been made relatively safe in recent years, but it does not offer the simplicity and speed of the scintillation camera study. Also, localized areas of decreased perfusion of a kidney are not identified by angiograms, as they are by scintiphotos.

The greater complexity of the cerebral circulation and the limited resolution obtained makes interpretation of cerebral perfusion pictures more complicated. However, the scintillation camera pictures do provide estimation of tissue perfusion not visualized by arteriograms. It should be noted that after the dynamic study is completed, brain scintiphotos of high resolution may be obtained by increasing exposure time to one or more minutes so that larger numbers of dots are accumulated. Such a static study is analogous to a conventional technetium brain scan.



Figs. 2A and 2B

Technetium-99m has been a very satisfactory isotope for the performance of these studies. It should be noted that useful visualization of blood flow can be obtained with as little as 0.5 millicuries of technetium-99m per injection. This sacrifices resolution in the image but permits repeated observations with acceptable radiation exposures. The conventional dose of 10 millicuries of technetium-99m has been estimated to give a whole-body radiation dose of 0.13 rads and 0.96 rads to the colon, the organ of maximum exposure, when studies are performed during perchlorate block of the thyroid (3).

#### SUMMARY

The scintillation camera has been used successfully to photograph blood flow and tissue perfusion in humans. Because of its simplicity, safety, and brevity, the procedure offers promise as a diagnostic method.

#### ACKNOWLEDGEMENT

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