

The LeVeen Shunt—A Technique for Testing Shunt Patency

Bonnie J. Baggenstoss, Allen L. Omdahl, Manuel L. Brown, and Heinz W. Wahner

Mayo Clinic and Mayo Foundation, Rochester, Minnesota

A modification of the test procedure for evaluation of the peritoneo-venous shunt is described. When Tc-99m sulfur colloid is introduced by intraperitoneal injection, scintiphotos of a patent shunt can usually be obtained immediately after injection. If the shunt is not visualized immediately, a liver scan must be obtained to distinguish ascitic fluid from functioning liver tissue. Cases in which this technique has been used show it to be a reliable method for assessing peritoneo-venous shunt patency.

The LeVeen shunt, developed to relieve intractable ascites, runs from the peritoneum along the right chest wall to the jugular vein, thus restoring ascitic fluid to the circulation. Retrograde flow is prevented by a one-way valve, which opens when the peritoneal pressure rises 3- to 5-cm H₂O above the intrathoracic venous pressure. However, since coagulation of blood in the valve can block the shunt (1), there is a need for an easy, innocuous test to determine shunt patency.

Radioactive techniques have been employed successfully to assess the function of other surgically placed shunts. For instance, radiopharmaceuticals are effective in assessing the function of the ventriculo-atrial shunt used in treatment for some types of hydrocephalus (2). Recently, Gorten (3) described a similar procedure to test the patency of the peritoneo-venous shunt. We describe a modification of Gorten's technique and our experience with it in three cases.

For reprints contact: Manuel L. Brown, Dept. of Diagnostic Nuclear Medicine, Mayo Clinic and Mayo Foundation, Rochester, MN, 55901.

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Materials and Methods

Materials needed for the shunt patency test include sterile gloves, sterile gauze sponges, povidone-iodine (Betadine, Purdue Frederick Co., Norwalk, CT), 1% lidocaine, a 20-ml syringe filled with saline, a three-way stopcock, a 23-gauge spinal needle, and a syringe containing 6 mCi of Tc-99m sulfur colloid.

The patient is placed in a supine position on the imaging table. A standard size scintillation camera can be employed for this procedure, but a large-field camera will best encompass the area that is to be imaged. The abdomen is scrubbed with Betadine and the injection site is anesthetized with 1% lidocaine. For the intraperitoneal injection, the 23-gauge spinal needle is coupled to the three-way stopcock, which also receives the 20-ml syringe filled with saline and the syringe containing 6 mCi of Tc-99m sulfur colloid (Fig. 1).

Frequently it is possible to see activity in the shunt tubing immediately after injection. Therefore, the technologist should be prepared to image the right anterior chest at the time the injection is made. Scintiphotos can be taken over the abdomen to visualize the distribution of sulfur colloid in the peritoneum, and then over the upper abdomen to check for accumulation in the liver.

If activity is not seen in the shunt or liver at this time, the pressure in the abdomen may not be great enough to activate the one-way valve. Breathing exercises such as a Valsalva maneuver should be performed to increase the abdominal pressure, and repeat scintiphotos should be taken.

If the shunt tubing is not visible in the immediate scintiphotos, a scintiphoto of the liver area is obtained at 24 hr and then a standard liver scan is performed.

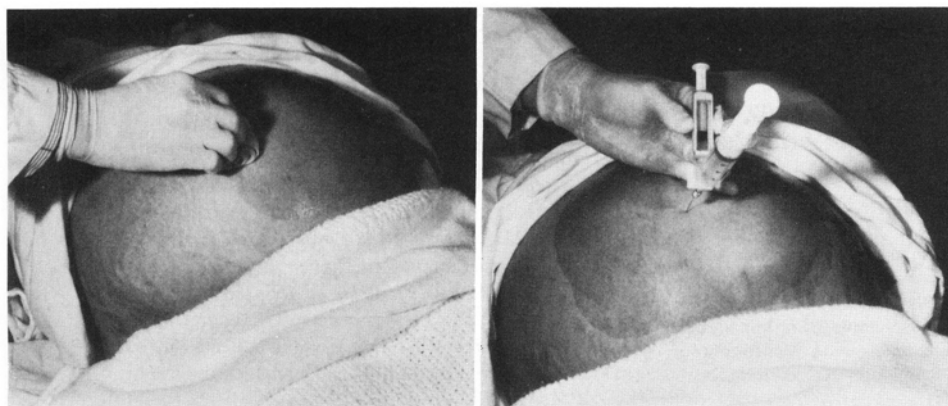


FIG. 1. After scrubbing (left) and anesthetizing (not shown) injection site, intraperitoneal injection is made with syringe assembly (right).

**TABLE 1. LeVeen Shunt Patency Test:
Suggested Method**

Procedure	Approx time after injection	Counts (large- field camera)
1. Intraperitoneal injection		
a. Image right anterior chest	Immediately	200,000
b. Image abdomen at injection site	2 min	1,000,000
c. Image liver area	5 min	1,000,000
If shunt tube is visualized, study is complete		
If tube is not seen, proceed to Step 2		
2. Breathing exercises (Valsalva maneuver)		
a. Repeat steps 1 a through c		
If shunt tube is visualized, study is complete		
If tube is not seen, proceed to Step 3		
3. 24-hr imaging		
a. Image liver area	24 hr	500,000
b. Image abdomen at injection site	24 hr	500,000
c. Inject Tc-99m sulfur colloid i.v., and image liver		1,000,000

Although images can be performed at 2 to 4 hr after injection, we wait for 24 hr in order to detect any delayed shunt function. We do this to locate the liver accurately and to distinguish it from the activity in the peritoneum. The suggested technique is outlined in Table 1.

Case Reports

Case No. 1: A 67-year-old woman with cirrhosis of

unknown cause and associated intractable ascites had a LeVeen shunt inserted. Postoperatively, she improved clinically but did not respond dramatically to the shunt placement. One week after surgery, a patency test was performed to check the function of the shunt. The intraperitoneal injection produced activity in the shunt immediately, proving its patency (Fig. 2).

The patient was readmitted one year later with complaints of abdominal pain and distention and symptoms of hepatic encephalopathy. A repeat test of patency showed no sign of function (Fig. 3).

Case No. 2: A 37-year-old man with ascites secondary to Budd-Chiari syndrome was referred for LeVeen shunt placement to relieve his massive ascites. After placement of the shunt, he experienced lower abdominal distress and a body-temperature spike to 38.9°C. A test of shunt patency showed activity in the shunt immediately, thus proving its function (Fig. 4). The fever persisted, and blood culture demonstrated gram-positive cocci. The shunt was thought to be the most likely site of infection; therefore it was removed.

Case No. 3: A 53-year-old man with postnecrotic cirrhosis, portal hypertension, and uncontrollable ascites had a LeVeen shunt placed. A patency test performed five days after surgery demonstrated activity within the shunt tube, verifying its patency (Fig. 5). The patient's course following shunt placement was uneventful.

Discussion

To test shunt patency, a method has been devised to detect fluid being drained from the peritoneal cavity into the circulatory system. After injecting a radio-pharmaceutical directly into the peritoneum, one can visualize the radioactivity as it flows through a patent shunt. Sulfur colloid is used because once it is introduced

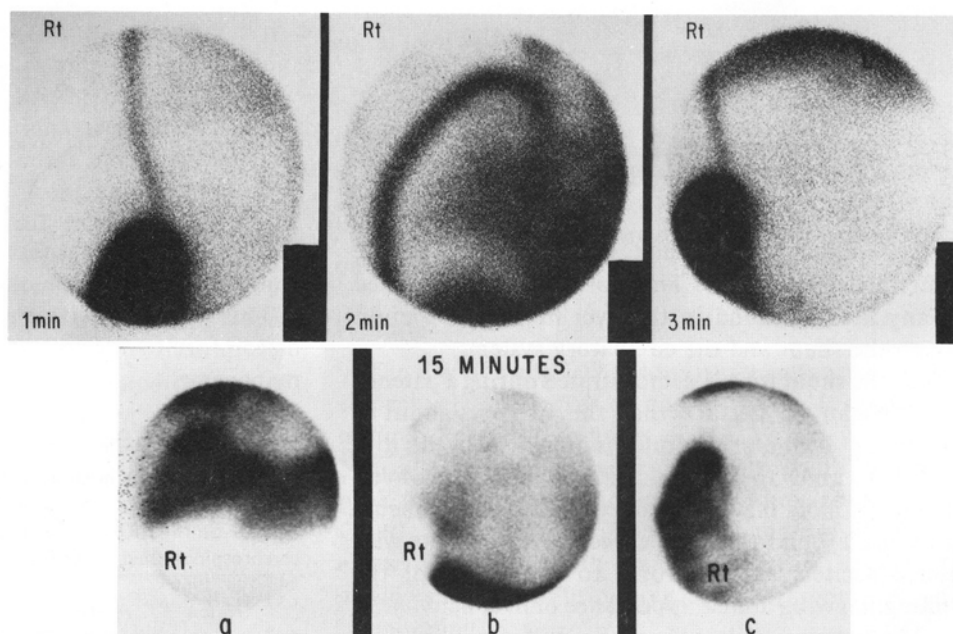


FIG. 2. (Case No. 1). Patent shunt. Immediate visualization of shunt tube along side of abdomen at 1 min, in chest at 2 min, and around injection site and in liver at 3 min. At 15 min, activity has accumulated within liver (a), anterior chest (b), and lower abdomen (c).

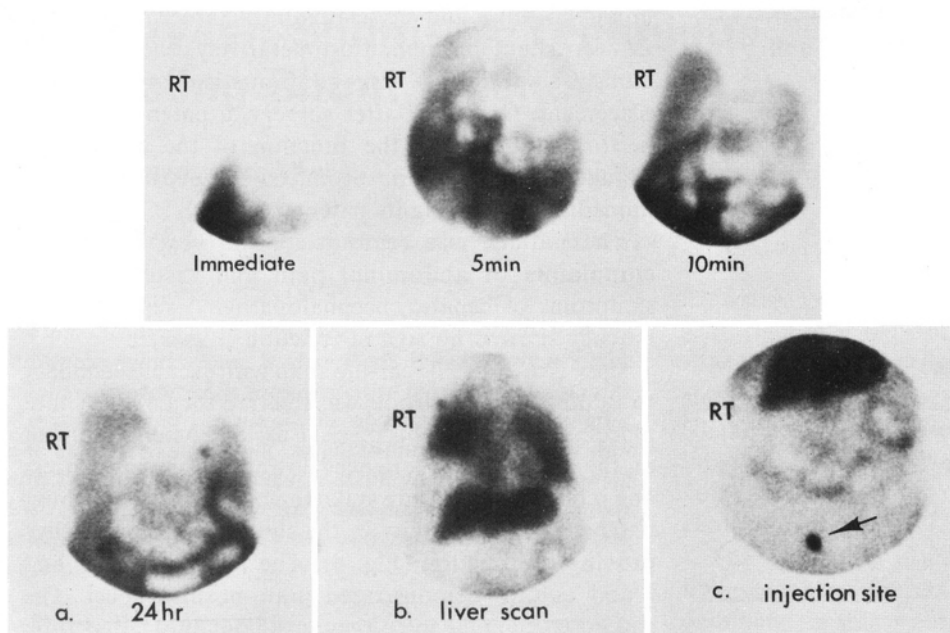


FIG. 3. (Case No. 1). One year later than Fig. 2: Nonpatent shunt. Immediate scintiphoto shows no evidence of shunt activity. At 5 min, peritoneum shows photon-deficient areas because of bowel loops. At 10 min, activity has diffused throughout peritoneum and conforms to shape of right hemidiaphragm, resembling liver activity. At 24 hr (a), distribution remains same as at 10 min. After new intravenous injection of Tc-99m sulfur colloid, true shape of liver is revealed (b). Arrow shows leakage of isotope around intraperitoneal injection site (c).

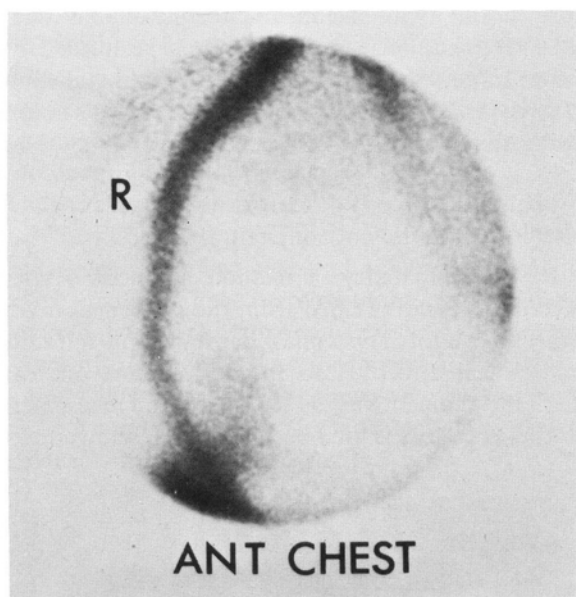


FIG. 4. (Case No. 2). Visualization of activity in tubing of patent shunt.

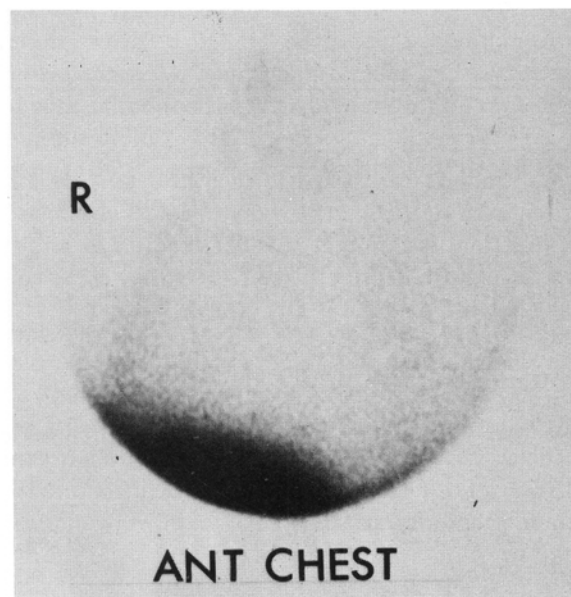


FIG. 5. (Case No. 3). Faint visualization in patent shunt.

into the circulatory system it will accumulate in the Kupffer cells of the liver. Therefore, it can be assumed that any activity found in the liver must have arrived through the shunt and the circulatory system.

When the shunt tube is demonstrated during a patency test, one can be certain that the LeVeene shunt is functioning. If the shunt tube is not visualized, it is necessary to know the configuration of the patient's liver. The sulfur colloid that is introduced into the peritoneum can diffuse around the liver, especially in patients with massive ascites, and conform to the shape of the diaphragm, giving a false appearance of liver activity. In this circumstance, comparison of a sulfur colloid liver

scan with the patency test will show whether the activity conforms to the shape of the patient's liver.

This test is easily performed without excessive discomfort to the patient, and it is helpful in clinical management.

REFERENCES

1. LeVeene HH, Christoudias G, Moon IP, et al: Peritoneo-venous shunting for ascites. *Ann Surg* 180: 580-590, 1974
2. Di Chiro G, Grove AS: Evaluation of surgical and spontaneous cerebrospinal fluid shunts by isotope scanning. *J Neurosurg* 24: 743-748, 1966
3. Gorten RJ: A test for evaluation of peritoneo-venous shunt function: Concise communication. *J Nucl Med* 18: 29-31, 1977