

	Ultrasonic nebulizer	B.A.R.C. nebulizer
Optimum volume of solution to be nebulized	10 ml	1 ml
Rate of nebulization	0.66 ml/min at speed position 7	0.0826 ml/min at 25 psi pressure*
Mass median diameter of aerosol particles	1.02 $\mu\text{m}$	0.84 $\mu\text{m}$
Geometric standard dev. in aerosol particle size	1.52 $\mu\text{m}$	2.08 $\mu\text{m}$
Range (66% limit)	0.67 $\mu\text{m}$ to 1.55 $\mu\text{m}$	0.40 $\mu\text{m}$ to 1.74 $\mu\text{m}$
Nature of aerosol	wet	dry
Cost in arbitrary units	100	10

\* = ca. 1300 mm Hg.

produce dry aerosol particles containing  $^{99\text{m}}\text{TcO}_4^-$  for lung imaging (1). We have now compared the performance of this aerosol generation and delivery system (called B.A.R.C.\* nebulizer) with that of an ultrasonic nebulizer†.

It is seen from Table 1 that the B.A.R.C. system delivers at a very low rate compared with the ultrasonic nebulizer, but the volume used for nebulization is also proportionately small, so that the wasted, unnebulized fraction becomes almost equal in both. Furthermore, the small volume required in the B.A.R.C. nebulizer makes it possible to use high-specific-activity solutions. Size distribution studies of aerosol particles from both nebulizers were made by using an Anderson Cascade Impactor (2). Both nebulizers were found to give comparable aerosol sizes, the particle-size distribution from the ultrasonic nebulizer being less dispersed. The great advantage of the B.A.R.C. nebulizer is that it produces dry aerosols. It is known that wet aerosols tend to deposit in major bronchi on their way to the alveoli, thus producing a heavy bronchial pattern in lung aerosol images. Figure 1 shows aerosol images obtained from a subject with the two nebulizers operating at the same compressed-air pressure. In both, the patient inhaled through the nose. As seen from the figure, the wet aerosol from the ultrasonic nebulizer tends to produce heavier deposition in

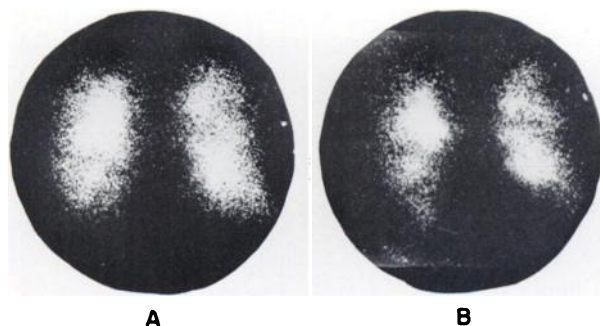


FIG. 1. Posterior views of a patient made with (A) B.A.R.C. nebulizer, and (B) ultrasonic nebulizer.

the major bronchi. The rate of nebulization in the ultrasonic nebulizer is nearly ten times that of the B.A.R.C., and hence the compressed air used for drying the ultrasonic aerosols is insufficient. To obtain completely dry aerosols from the ultrasonic nebulizer, ten times the air flow would be required, which is uneconomical and inefficient. The inexpensiveness of the B.A.R.C. nebulizer is an attractive factor when resources are limited. This nebulizer is now in routine use with us for clinical studies in patients with chronic obstructive pulmonary disease, and there have been no problems.

U. R. RAIKAR  
R. D. GANATRA  
B. RAGHUNATH  
Bhabha Atomic Research Center  
Bombay, India

#### FOOTNOTES

\* B.A.R.C. = Bhabha Atomic Research Center.

† De Vilbiss 35A, 1.35 MHZ.

#### REFERENCES

1. KOTRAPPA P, RAGHUNATH, SUBRAMANYAM PSS, et al: Scintiphography of lungs with dry aerosol—Generation and delivery system. *J Nucl Med* 18: 1082–1085, 1977
2. MERCER TT: *Aerosol Technology in Hazards Evaluation*. New York, Academic Press, 1973, p 237

#### Effect of Phenobarbital on Liver Uptake of Ga-67

After i.v. administration, gallium-67 citrate is taken up by liver cells. Subcellular Ga-67 is associated with lysosomes and probably also with a microsomal fraction within the cell (1,2). One possible explanation for this subcellular distribution is that Ga-67 may have a specific affinity for certain enzymes within these organelles. Various metals can substitute for iron in enzymes during iron deficiency (3) and Ga-67 does compete with iron for binding sites on the blood protein transferrin. In this context, binding of Ga-67 to one or more microsomal enzymes could account for at least some of the observed localization.

Phenobarbital is known to increase the amount of enzymes of the microsomal system, i.e. cytochrome P-450, cytochrome b<sub>5</sub>, aniline hydroxylase, and aminopyrine demethylase. An increase is also found in smooth endoplasmic reticulum (SER), in protein concentration (including the anionic transport proteins Y and Z), in liver weight, and possibly in the RNA content of liver cells (4,5). These represent only a few of the known effects phenobarbital has on the body, but the relationship of Ga-67 to these effects can be looked at rather easily.

Balb/c mice were given daily intraperitoneal injections (0.1 ml  $\approx$  1.2 mg) of phenobarbital for six days. Control mice were injected with 0.1 ml soybean oil (the delivery solution for the phenobarbital) at the same time as test mice. On day eight, all mice were injected with 0.25  $\mu\text{Ci}$  Ga-67 citrate in 0.20 ml saline (a dose found to give high percentage uptake in this laboratory). On the ninth day the mice were killed and body samples were weighed and counted in a gamma counter. A standard dose was counted at the same time to be used in the calculation of a percentage dose uptake.

The liver-to-body weight ratio was significantly\* higher

TABLE 1. EFFECT OF PHENOBARBITAL (Phb) ON LIVER SIZE AND Ga-67 UPTAKE

Group		grams	% BW	% dose	% dose g	% dose g	adjusted†
n = 10							
Control:	mean	1.4736	0.0624	13.43	9.37	—	—
	sem	0.10	0.0015	0.61	0.55	—	—
n = 9							
Phb treated:	mean	1.6470	0.0765	12.03	7.46	8.45	8.45
	sem	0.12	0.0020	0.83	0.59	0.67	0.67
	P	>.2	<.001	>.2	<.05	<.05	>.2

\* P is the probability that difference from control is due to random error.

† Refer to text.

( $p < .001$ ) in the phenobarbital mice than in control mice. Therefore the barbiturate effect on microsomal enzymes and SER mentioned may be assumed to have occurred.

When computed, the uptake of Ga-67, measured by % dose/g, was significantly less ( $p < .05$ ) in the treated livers than in the control livers. But if the treated liver weight is adjusted to what a similar control weight would be, using the formula:

$$\text{adjusted wt}_1 = \text{treated liver wt}_1 \times \frac{\text{ave. control wt.}}{\text{ave. treated wt.}}$$

and the % dose uptake/g for adjusted liver weight is then recomputed, the control and phenobarbital groups are not significantly different. This suggests that the apparent decrease in uptake could be explained by a dilution of Ga-67 binding sites. Because there is an increased concentration of liver proteins and enzymes without additional uptake of 67-Ga, a specific binding site is implicated here as in previous papers, but the subcellular binding site for Ga-67 is not the microsomal enzymes, SER, or any other cell component increased by phenobarbital treatment.

TODD HUBBARD  
STEVEN M. LARSON  
DAVID R. ALLEN  
Veterans Administration Hospital  
and University of Washington  
Seattle, Washington

## FOOTNOTE

\* Significance is measured with the Student's t-test.

## REFERENCES

- BROWN DH, BYRD BL, CARLTON JE, et al: A quantitative study of the subcellular localization of  $^{67}\text{Ga}$ . *Cancer Res* 36: 956-963, 1976
- HAYES RL: The tissue distribution of gallium radionuclides. *J Nucl Med* 18: 740-742, 1977
- GILLETTI JR, CONNEY AH, COSMIDES GH: *Microsomes and Drug Oxidations*. New York, Academic Press, 1969
- ADACHI Y, YAMAMOTO T: Influence of drugs and chemicals upon hepatic enzymes and proteins—I. Structure-activity relationship between various barbiturates and microsomal enzyme induction in rat liver. *Biochemical Pharmacology* 25: 663-668, 1976
- CONNEY AH: Pharmacological implications of microsomal enzyme induction. *Pharmacological Reviews* 19: 317-368, 1967

### Saphenous Vein Varicosities—The Use of Tc-99m-RBC Blood-Pool Imaging for Evaluation and Followup

There are two main venous systems that channel the blood return from the lower limbs: the superficial veins in the superficial fascia immediately beneath the skin, and the deep veins, which always accompany arteries and are usually enclosed in the same sheath. Venous dilatations, or varicosities, of the superficial system are a consequence of disruption of the normal blood return and may or may not be symptomatic. The treatment possibilities for those cases in which they are symptomatic are various, including conservative, sclerosing, and/or surgical procedures. Before the physician is able to make his choice of treatment, the patient must be subjected to a thorough clinical examination, which

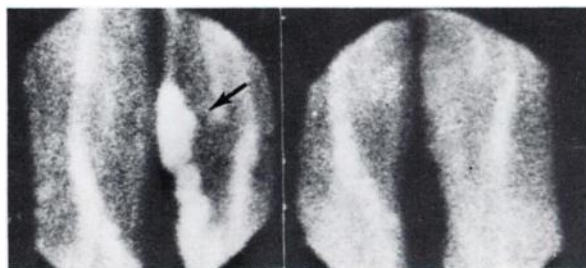


FIG. 1. Posterior view of varicose veins of right leg. Left: Immediately before sclerotizing treatment, arrow pointing to varicose vein. Right: 3 wk later; disappearance of blood pool of varicose veins is evident.



FIG. 2. Internal lateral view of severely dilated veins of right knee. Left: Before treatment. Right: 2 mo after sclerotizing injection.