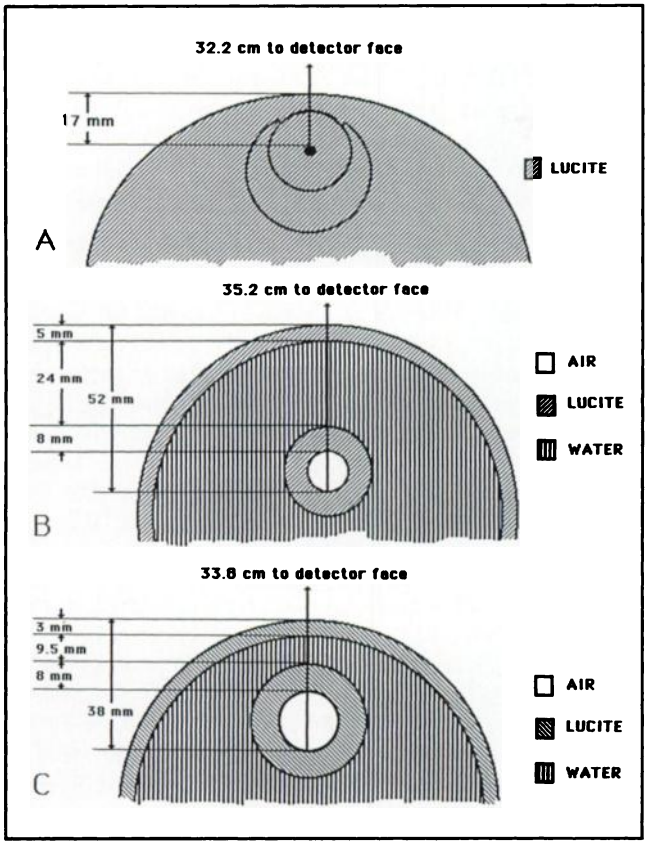

FIGURE 1. Materials of construction and dimensions of the three thyroid neck phantoms. The distance from the capsule location to the face of the detector is also shown. The total absorber thickness between the capsule and the top of the phantom is considerably different for the three devices, accounting for the attenuation differences among the three. In addition, the distance from the capsule to the detector face is also different for the three phantoms, producing the counting geometry differences among them. (A) Standard IAEA lucite phantom. (B) "Old" water phantom. (C) "New" water phantom.

cient (μ) at 159 keV for Lucite is approximately equal to water, which is 0.147/cm]. Geometry correction factors were then calculated to account for the differences in the distances from the capsule to the face of the detector. With the Lucite phantom, the capsule lies 32.3 cm from the detector. This distance is 35.2 cm for the "old" water phantom, and 33.8 for the "new" phantom (the distance from the detector to the top of each phantom was set at 30 cm). The results are given in Table 2. When the count ratios of Table 1 are multiplied by the total correction factors of Table 2, the water phantom counts are corrected to the IAEA Lucite phantom to within a few percent. These results confirm that the physical difference among the two phantoms is the cause of the relatively high thyroid uptake values obtained using the water phantoms.

TABLE 2
Theoretical Attenuation and Geometry Corrections for Three Phantoms

Phantom	Correction		
	Attenuation	Geometry	Total
Lucite	1.00	1.00	1.00
"Old" water-filled	1.323	1.196	1.582
"New" water-filled	1.049	1.101	1.155

Absorber thickness and distances from capsule to detector face are shown in Figure 1. Counts per minute obtained with the designated phantom are multiplied by the correction to obtain values comparable to the IAEA Lucite phantom.

The new version of the water filled phantom uses a thinner Lucite (11 mm versus 16 mm) and a thinner water layer (9.5 mm versus 21 mm). Although the absorber thickness has been decreased, this newer water phantom still provides approximately 15% more attenuation than the solid Lucite phantom. Thyroid uptake values will therefore be higher with either of the water phantoms relative to the solid Lucite phantom.

Summary

The main purpose of this communication is to alert nuclear medicine departments to the fact that the earlier version of the water phantom grossly overestimates soft-tissue attenuation in the neck, resulting in calculated thyroid uptake values which are significantly overestimated (in hyperthyroid patients we noted uptake values approaching or exceeding 100%). We believe that the solid Lucite phantom (which is the one recommended by IAEA) better approximates the human neck soft tissue overlying the thyroid. Institutions that continue to use the water phantom should be aware that their thyroid uptakes will be relatively elevated and the normal range must be shifted accordingly. Our normal range is 10%–30% uptake of ^{123}I at 24 hr for the Lucite phantom. For the water phantom, the estimated normal range would be 15%–45%.

In addition, the phantom type should be considered when comparing uptake results with those from another institution for a particular patient. Also, treatment doses for Grave's disease could be significantly affected, if such doses are calculated by a formula that depends on uptake.

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Economic Advantages of Xenon-127 over Xenon-133

TO THE EDITOR: We would like to elaborate on the recent letter of M. V. Merrick (*1*) concerning the advantages of ^{127}Xe over ^{133}Xe. The technical superiority of ^{127}Xe over ^{133}Xe for lung ventilation studies and for cerebral blood flow measurement have been well documented (*2,3*). These factors can lead to economic advantages as well, as Dr. Merrick discussed.

Unfortunately, ^{127}Xe is now viewed as an exotic isotope with only intermittent availability. This opinion arose because ^{127}Xe has been produced solely at high-energy accelerators, such as the Brookhaven Linac Isotope Producer (BLIP), which do not operate

year round. This circumstance contributed to the decision by Mallinckrodt Medical Inc., the only commercial supplier in the United States, to withdraw the isotope from the market. However, recently the feasibility of reactor production of ^{127}Xe from enriched ^{126}Xe has been studied here at Brookhaven as well as in Canada and the Soviet Union (*4*). This method has the potential to supply ^{127}Xe continuously and make the use of ^{127}Xe routine in the clinic.

REFERENCES

1. Merrick MV. Cost considerations for xenon-121. *J Nucl Med* 1991;32:1642.
2. Atkins HL, Susskind H, Klopper JF, Ansari AN, Richards P, Fairchild RG. A clinical comparison of ^{127}Xe and ^{133}Xe for ventilation studies. *J Nucl Med* 1977;18:653–659.
3. Coppola R, Marenco S, Jones DW, David DG, Weinberger DR. Assessment of ^{127}Xe as a dynamic SPEC rCBF tracer in normal subjects at rest. *Soc Neurosci Abs* 1990;16:23.
4. Vereshchagin YI, Prusakov VN, Yashin AF. Xenon-127 production in a reactor for medical applications. Fourth European Symp. Radiopharmacy and Radiopharmaceuticals. Baden, Switzerland, May 1–4, 1991.

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Evaluation of Heparin and Anticoagulant Citrate Dextrose in the Preparation of Technetium-99m-Red Blood Cells with UltraTag® RBC Kit

TO THE EDITOR: Recently, the Food and Drug Administration approved a new kit for the in vitro preparation of ^{99m}Tc-labeled red blood cells (RBCs). The UltraTag® RBC kit (Mallinckrodt Medical, Inc., St. Louis, MO) is a modification of the in vitro labeling RBC kit developed by the Brookhaven National Laboratory (*1,2*). We would like to bring attention to a potential problem we have found concerning the usage of the UltraTag® RBC kit for radiolabeling RBCs.

The package insert of the UltraTag® RBC kit recommends collecting the patient's blood sample (1.0 to 3.0 ml) using either heparin or ACD (anticoagulant citrate dextrose; acid citrate dextrose) as an anticoagulant (*3*). Unfortunately, the package insert fails to mention the amount of anticoagulant which should be used. For preventing coagulation of the laboratory blood sample, the package insert of Heparin Sodium Injection, USP (Elkins-Sinn, Inc., Cherry Hill, NJ) gives a recommended dosage of approximately 3.5–15 units heparin sodium per 1 ml of whole blood (*4*). ACD Solution, USP formula A (Baxter Healthcare Corporation, Deerfield, IL) is primarily designed to be utilized in apheresis procedures (*5*). There is no formal package insert available to instruct the user as to the volume of ACD which should be used to prevent coagulation of the whole blood sample (*personal communication*). However, Masouredis (*6*) suggests that a volume of 67.5 ml ACD can be added to 450 ml of whole blood. This equates to a ratio of 0.15 ml ACD to be employed as an anticoagulant solution for each milliliter of whole blood.

For our study, we collected 3-ml whole blood samples from a volunteer group using an anticoagulant of either 20-unit heparin dissolved in 1 ml 0.9% NaCl or 0.45 ml ACD diluted to 1 ml with 0.9% NaCl. Sodium pertechnetate eluted from a 3.0 Ci (111 GBq) technetium generator (Ultra-TechneKow® FM Generator, Mallinckrodt Medical, Inc., St. Louis, MO) with ingrowth time of either 24 or 72 hr was used as the ^{99m}Tc source. Typically, the ^{99m}Tc eluate with 24-hr ingrowth was obtained from a ^{99m}Tc generator which was eluted within the past 24 hr, whereas the 72-hr ingrowth eluate was obtained from a Monday generator (a generator manufactured on a Friday, but not eluted until the following Monday morning). Forty millicuries (1,480 MBq) of sodium pertechnetate ^{99m}Tc (in a volume of 1 ml) at different eluate ages of 0.25 hr, 2 hr, 6 hr, and 12 hr were added to the reaction vial for labeling RBCs. The labeling efficiencies (LE) of heparin versus ACD were then measured immediately and 30 min after preparation following the package insert's recommended method for assaying LE (*3*). According to the package insert of the UltraTag® RBC kit, LE is usually greater than 95% (*3*).

The results of these studies (Table 1) have indicated that the recommended dosages for both heparin and ACD give ^{99m}Tc-RBCs LE greater than 90% when prepared with 24-hr ingrowth ^{99m}Tc eluate. However, unlike heparin, the recommended dosage for ACD was unsuitable for use as an anticoagulant with ^{99m}Tc eluate from a 72-hr ingrowth time generator in the preparation of ^{99m}Tc-RBCs using the UltraTag® RBC kit (Fig. 1). Since the package insert of the UltraTag® RBC kit does not require that quality control be performed prior to reinjection of ^{99m}Tc-RBCs to the patient, the patient could receive unnecessary radiation exposure due to the high percentage of unbound ^{99m}Tc with the use of eluate from a long-ingrowth-time generator.

Porter et al. have demonstrated that the usage of heparin in the preparation of ^{99m}Tc-RBCs results in distinct renal and blad-

TABLE 1
Labeling Efficiencies of ^{99m}Tc-RBCs Prepared With 24-Hr Ingrowth Tc-99m Eluate: ACD versus Heparin

Eluate age (hr)	n	Heparin		ACD	
		0 min	30 min	0 min	30 min
0.25	3	95.86 ± 1.28	98.93 ± 0.70	97.70 ± 0.27	98.93 ± 0.42
2	3	93.20 ± 2.13	98.93 ± 0.15	94.22 ± 1.04	98.52 ± 0.70
6	3	94.13 ± 1.49	98.91 ± 0.16	97.34 ± 0.29	99.33 ± 0.06
12	3	95.71 ± 0.82	98.93 ± 0.10	93.55 ± 2.62	98.61 ± 0.63

All differences between corresponding values are not statistically significant (two tailed t-test).