seems logical for it to be present as a cation to form a chelate, as is the case with other transition metals. This is also in agreement with recent carrier ^{99m}Tc electrophoresis data.

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REFERENCES

1. ECKELMAN W, MEINKEN G, RICHARDS P: The chemical state of technetium in biomedical products. II. The chelation of reduced technetium with DTPA. Submitted to *J Nucl Med*

2. RICHARDS P, ATKINS HL: Technetium-99m labeled compounds: Proc. 7th Annual Meeting of the Japanese Nuclear Medicine Society, Tokyo, Japan, Nov. 17–18, 1967, Tokyo Radioisotope Assoc, 1968, pp 165–170

A SIMPLER METHOD FOR OPTIMIZING THE WINDOW OF THE ANGER CAMERA FOR ^{99m}Tc

The procedure for optimizing the window of an Anger camera for ^{99m}Tc proposed by Sanders et al (*J Nucl Med* 12: 703–706, 1971) does indeed provide a significant improvement in scan quality, as shown in their paper, but the method has two disadvantages. First, the use of a small ^{99m}Tc source to determine the counting rate response over the range of "isotope peak" settings in effect produces a response curve for only a few of the 19 photomultiplier tubes in the array. Second, obtaining the counting rate over the full range of the "isotope peak" potentiometer may take several minutes.

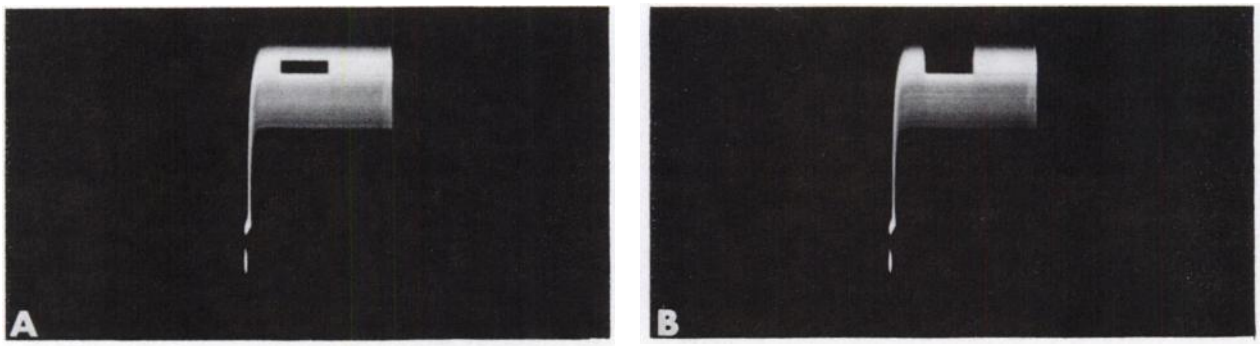

FIG. 1. In A 10% window is centered on photopeak of 140-keV gamma ray of ^{99m}Tc. In B, without any other adjustments, window width is increased to 25%. Window now covers energy range of 133–167 keV.

I have modified the technique of optimizing the window to overcome both of these problems. First, the method is used only with an extended source of ^{99m}Tc which may be a flood source or a patient who has received millicurie amounts of ^{99m}Tc for diagnostic examination. Second, by setting the window at 10%, the isotope peak dial is turned until the ^{99m}Tc photopeak is centered in the window as shown in Fig. 1A. Then without further adjustment the window width is increased to 25%. The effect on the photopeak window is shown in Fig. 1B.

The method is simple and while not exactly as accurate as the technique described by Sanders et al, we have observed the same marked improvement in scintiphotos obtained by using this optimized window.

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FEASIBILITY OF ^{133m}Ba AS A BONE SCANNING AGENT

Parenterally administered barium salts are largely bone seekers, and ^{131}Ba and ^{135m}Ba have been used as bone scanning agents (*1,2*). Both ^{131}Ba and ^{135m}Ba suffer from being produced from expensive, isotopically enriched stable targets. Another barium radionuclide, ^{133m}Ba, also has desirable properties as a scanning agent. In addition to reactor production from ^{132}Ba by the n,γ reaction, it can also be made by the ^{133}Cs(p,n) reaction in a cyclotron (*3*).

Barium-133m decays ($T_{1/2}$ = 38.9 hr) by emission of a 276-keV gamma ray to ^{133}Ba which is itself radioactive ($T_{1/2}$ = 7.2 years). Although associated with all of the disintegrations of ^{133}Ba, the 276-keV gamma ray is highly internally converted so that a

TABLE 1. ^{133m}Ba DOSE CALCULATIONS*

Radionuclide	Rads/μCi injected: Skeleton	Rads/μCi injected: Total body	Injected dose to bone (%)
^{133m}Ba-^{133}Ba	0.00257	0.000459	60
^{135m}Ba	0.001176	0.000178	60
^{131}Ba-^{131}Cs	0.00648	0.001840	60
^{85}Sr	0.02759	0.009367	70
^{87m}Sr	0.0000640	0.0000151	70
^{18}F	0.0001113	0.00002556	53

* The assumption is that 60% of the injected dose goes to bone and decays there with a $T_{1/2}$ of 38.9 hr. The ^{133m}Ba deposited in bone is assumed to decay to ^{133}Ba which decays with an effective half-life equal to the physical half-life (7.2 yrs).

TABLE 2. ^{133m}Ba EQUILIBRIUM ABSORBED DOSE CONSTANTS

Radiation$_i$	No/dis n_i	Energy$_{(MeV)}$ E_i	Δ_i (gm-rad/μCi-hr)
Electron capture	1.0	—	—
γ_1	0	0.01129	—
e_{L_I}, γ_1	0.67	0.00669	0.0095
e_M, γ_1	0.33	0.01123	0.0078
γ_2 0.276 keV	0.175	0.2757	0.1027
e_K, γ_1	0.595	0.2383	0.3019
e_{L_I}, γ_1	0.172	0.2701	0.0989
e_M, γ_1	0.057	0.2756	0.0334
$K_{\alpha 1}$ x-ray	0.283	0.0322	0.0193
$K_{\alpha 2}$ x-ray	0.147	0.0318	0.0099
$K_{\beta 1}$ x-ray	0.080	0.0364	0.0062
$K_{\beta 2}$ x-ray	0.017	0.0374	0.0013
L—x-ray	0.180	0.0045	0.0017
KLL Auger electrons	0.047	0.0263	0.0026
KLX Auger electrons	0.021	0.0308	0.0013
KXY Auger electrons	0.003	0.0353	0.0002
LMM Auger electrons	1.206	0.0034	0.0086
MXY Auger electrons	3.087	0.0011	0.0071
38.9 hr	^{133m}Ba	0.288	
	↓	γ_2 0.01229	
	↓	γ_1 0	

γ_1 assumed to be completely converted in M and L shells.

$\gamma_2 \frac{e_K}{\gamma} = 0.34$, K/L + M . . . = 2.6.

This yield of ^{133}Ba is ~6 × 10^{-4} μCi/μCi of ^{133m}Ba. The calculations for ^{133}Ba have been published in Dillman LT: Radionuclide decay schemes and nuclear parameters for use in radiation dose estimates, Part 2. MIRD Pamphlet No 6, *J Nucl Med* 11: Supplement 4, 5–32, 1970.

gamma ray is emitted in only 17% of the disintegrations. One millicurie of retained ^{133m}Ba decays to only 0.6 μCi of ^{133}Ba. Dose calculations are shown in Tables 1 and 2.

A sample of ^{133m}Ba, cyclotron produced, was kindly supplied by Dr. Larry Brown of the Oak Ridge National Laboratory as $^{133m}BaCl_2$ in 0.1 *M* HCl (2.2 mCi/ml). This was neutralized, filtered and boiled, taken to dryness, and dissolved in sterile isotonic saline. Dogs were injected with 1 mCi each, and blood samples were drawn periodically. The blood disappearance curve was similar to that described with ^{131}Ba (*1*). Bone scans of good quality were obtained with both rectilinear scanners and a gamma-ray camera. It should be noted that ^{133m}Ba, like other barium and strontium isotopes, is excreted in the bowel; scans of the pelvic area should be preceded by thorough cleansing of the gastrointestinal tract.

The short physical half-life of ^{133m}Ba contributes to the low radiation dose (even with the contribution from ^{133}Ba). Despite the highly converted emission there is a significant dose reduction over the commonly used ^{85}Sr. The ability to produce ^{133m}Ba in either a nuclear reactor or cyclotron is of particular interest.

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REFERENCES

1. SPENCER RP, LANGE RC, TREVES S: Use of ^{135m}Ba and ^{131}Ba as bone-scanning agents. *J Nucl Med* 12: 216–221, 1971

2. HOSAIN F, SYED IB, WAGNER HN: Ionic ^{135m}Ba for bone scanning. *J Nucl Med* 11: 328, 1970

3. LEDERER CM, HOLLANDER JM, PERLMAN I: *Table of Isotopes*, 6th ed, New York, John Wiley & Sons, 1967, pp 76, 478

INHALATION LUNG SCANNING

There appears to be a logical fallacy in two papers recently published in the *Journal of Nuclear Medicine*. In the paper, "Radioaerosol inhalation lung scanning: Its role in suspected pulmonary embolism" (*J Nucl Med* 12: 606–609, 1971) Isawa, et al begin with the premise that "a diagnosis of pulmonary embolism cannot be made by perfusion scanning alone." The conclusion of the paper seems to be that aerosol inhalation scanning helps to make the diagnosis of pulmonary embolism. This conclusion is derived from studies on 28 patients with a final diagnosis of pulmonary embolism "based on the discrepancy between perfusion and aerosol deposition patterns." This appears to be begging the ques-