nm/PRELIMINARY NOTE

^{131}Ba: AN INTERMEDIATE-LIVED RADIONUCLIDE FOR BONE SCANNING

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While ^{18}F may be the radionuclide of choice for bone scanning, its short half-life precludes distribution at a distance from the production site and also rules out the possibility of late scans. Short-lived ^{87m}Sr is expensive, and Charkes has pointed out some of the difficulties in its use (*1*). Perhaps the most commonly used radionuclide for bone scanning, ^{85}Sr, has the disadvantage of a long physical half-life which limits the quantity that can be administered. Aside from studies by McAfee and coworkers (*2*) there have not been recent reports of other usable bone-seeking radionuclides. We wish to report the use of an intermediate-lived bone-seeking agent, ^{131}Ba, as a bone-scanning substance.

Barium is a member of Group II of the periodic table; this is the group that also includes the elements calcium, strontium and radium. Despite this resemblance to the known bone seekers and a few reports on barium uptake by the skeletal system (*3*), we can find no literature mention of the use of ^{131}Ba as a bone-scanning material. This radionuclide possesses three distinct advantages over ^{85}Sr, as the comparison of the two nuclides in Table 1 shows.

TABLE 1. COMPARISON OF ^{131}Ba AND ^{85}Sr

	^{131}Ba	^{85}Sr
Half-life (days)	11.6	64
Equilibrium absorbed dose constant $\left(\frac{\text{gm-rad}}{\mu\text{Ci-hr}}\right)$	0.857	1.123
Principal emissions in keV (number/disintegration)	496 (0.45) 373 (0.13) 216 (0.19) 124 (0.26)	514 (0.99)

First, the half-life of ^{131}Ba is considerably shorter than that of ^{85}Sr. Second, the equilibrium absorbed dose constant of ^{131}Ba is only 76% of that of ^{85}Sr (calculations will be presented in later studies). These two factors mean that the radiation dose delivered per microcurie of deposited ^{131}Ba is only about one sixth that of ^{85}Sr. Third, conventional scanning devices as well as large-diameter detectors (such as gamma-ray cameras) are more efficient for the lower energy emissions of ^{131}Ba than for the 496-keV gamma ray of ^{131}Ba or the 514-keV emission of ^{85}Sr. This means that with a wide pulse-height window, the 1.03 emissions/disintegration of ^{131}Ba are more efficiently detected than the 0.99 emissions/disintegration of ^{85}Sr. Indeed, for the same radiation exposure, we can use nearly six times as much ^{131}Ba as ^{85}Sr and obtain nearly ten times the counting rate. Limiting the pulse-height window to the lower energy gamma rays of ^{131}Ba also allows imaging (although there is still Compton scatter into this range). Whereas ^{85}Sr can not be effectively used with gamma-ray cameras, ^{131}Ba can still be used.

After intravenous administration to human sub-

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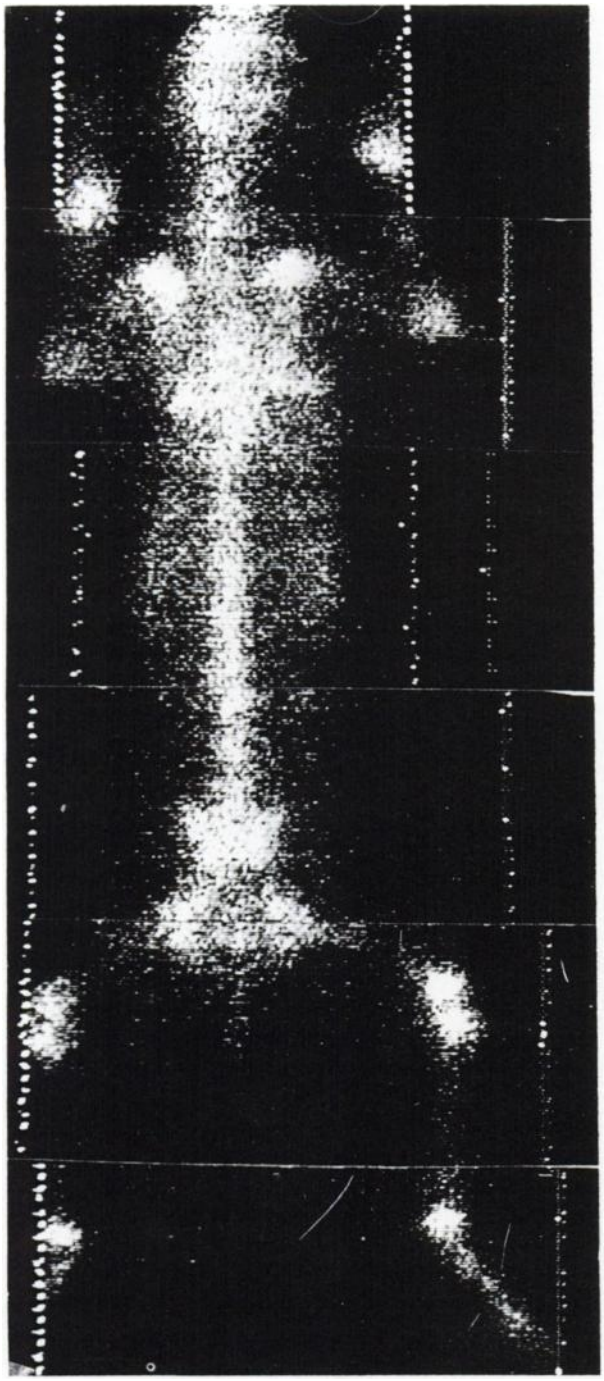

FIG. 1. Composite Dynapix scan, taken from posterior, of adult dog. Scan was obtained 2 hr after intravenous administration of 800 μCi of $^{131}BaCl_2$. Localization in skeletal system can be noted, as well as some activity that probably represents residual blood-pool counts and gastrointestinal secretion.

jects, ^{131}Ba (as the chloride, from Oak Ridge National Laboratories) rapidly disappears from the blood stream. At 2 hr only about 8% of the injected dose could be detected in the blood. This means that bone scans can be obtained at an early time as well as at later intervals. To illustrate this, a scan performed 2 hr after the intravenous administration of $^{131}BaCl_2$ is shown in Fig. 1.

Distribution and retention studies on animals and initial clinical experiences will be detailed in later publications. The limiting factor to the use of ^{131}Ba as an agent to replace ^{85}Sr may be a production problem. When a nuclear reactor is used to produce ^{131}Ba by the ^{130}Ba (η,γ) reaction, enriched ^{130}Ba must be used if high-specific-activity ^{131}Ba is desired. There is also the possibility of cyclotron production of this radionuclide by the ^{133}Cs $(p,3\eta)$ ^{131}Ba interaction (*4*).

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