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Tissue Distribution of ^{203}Pb-Acetate: Comparison with ^{67}Ga-Citrate as an Abscess-Localizing Agent

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Since ^{203}Pb-acetate accumulates in necrotic tumor tissue, the possibility was raised that it might also accumulate in other necrotic tissue such as abscess. We first studied the tissue distribution and excretion of ^{203}Pb-acetate in control rats at 4, 24, 48, 72, and 96 hr. An enterohepatic circulation for lead is suggested. We then compared the uptakes of ^{203}Pb-acetate and ^{67}Ga-citrate in experimental abscesses in rats. The mean gallium accumulation in the abscess was 10 times that of lead at 24 hr and 12 times that of lead at 72 hr. The abscess-to-tissue ratios were greater for gallium for every tissue examined, although the abscessed areas were clearly visualized by scanning at 24 and 72 hr with both agents. With the exception of blood, abscess-to-tissue ratios for ^{67}Ga at 24 hr were higher than or equal to those at 72 hr. However, the ^{67}Ga ratios for the inflamed tissue surrounding the abscess to muscle and blood were higher at 72 hr than at 24 hr, which suggests that inflammation without abscess might be better identified by gallium scanning at 72 hr.

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Lead-203-acetate, with its 81%-abundant 279-keV gamma emission and 52-hr half-life, is potentially useful for clinical scanning. In the carrier-free form, an imaging dose of 1–5 mCi contains only nanogram quantities of lead, an amount less than one-thousandth of the normal daily lead intake (*1*). Preliminary studies of ^{203}Pb in a rat hepatoma model showed significant accumulation in necrotic tumor tissue (*2*). This observation led us to consider the possibility that ^{203}Pb also accumulates in other necrotic or potentially necrotic tissue, such as areas of abscess or infection.

Gallium-67-citrate, while useful as an abscess-scanning agent, is not ideal since its accumulation in the liver, spleen, and bowel may make interpretation below the diaphragm difficult (*3–5*). Therefore, metabolic studies were first conducted in rats to determine the distribution and excretion of carrier-free ^{203}Pb-acetate, followed by a comparative study of the accumulation of ^{203}Pb and ^{67}Ga in experimental staphylococcal abscesses in rats.

MATERIALS AND METHODS

Lead-203 body-distribution study. Twenty-five male Sprague–Dawley rats, weighing from 208 to 314 gm, were included in a control group for baseline studies. All rats were anesthetized with ether, and 30 μCi of ^{203}Pb-acetate (New England Nuclear Corp., North Billerica, Mass.) was injected into the tail vein. The rats were housed in metabolic cages with free access to food and water, and their urine and feces were collected separately at 24-hr inter-

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vals. Groups of five rats were killed by direct cardiac puncture and exsanguination at 4, 24, 48, 72, and 96 hr after injection. Samples of blood, small intestine, and gastrocnemius muscle were removed and weighed. The total weights of the animals' blood, small intestine, and muscle were estimated by taking 7%, 1.7%, and 40% of the body weight, respectively (*6*). One kidney and the entire colon were removed, weighed, and counted; stool in the colon was included in the excretion portion of the study. The liver was removed and weighed, and then several samples representing approximately 10% of the liver mass were counted. The skin covering the right forelimb was retracted and the joint removed by severing the limb approximately 0.5 cm distal and 0.5 cm proximal to the joint.

Tissue samples, except for blood, were washed in water and 10% formalin and then blotted dry. All samples, including blood, urine, and feces, were counted in an automated Searle Radiographics well counter centered on the 279-keV ^{203}Pb photopeak with a 20% window.

Comparison of ^{203}Pb and ^{67}Ga in abscess localization. Forty male Sprague–Dawley rats, weighing 290–390 gm, were injected in the left forelimb muscles with 0.5 ml of trypticase soy broth containing approximately 5×10^{12} cells of coagulase-positive *Staphylococcus aureus* and 5 mg of talc. To augment the infection, the rats were reinoculated in the same location 3 days later with 0.25 ml of the trypticase soy broth containing approximately 10^{12} staphylococci; a 1-cm piece of OOO surgical silk was placed on the tip of the 21-gage needle and injected simultaneously with the second staphylococcal medium. All the rats developed a limp and a significant increase in size of the injected limb.

The rats were divided into four groups: Groups 1 and 2 contained 16 animals each and Groups 3 and 4 had four animals each. Six days after the second inoculation, 100 μCi of ^{203}Pb-acetate was injected into the tail vein of each rat in Group 1, and 50 μCi of ^{67}Ga-citrate (New England Nuclear Corp.) was injected into the tail vein of each rat in Group 2. At 24 hr after injection, eight animals from each of these two groups were anesthetized with ether and killed by direct cardiac puncture and exsanguination. The remaining eight animals from Groups 1 and 2 were anesthetized and killed at 72 hr. With the exception of the abscessed forelimb, tissues were collected and processed as described for the control animals. The skin covering the forelimbs was retracted and the abscessed tissue sample was obtained by severing the limb approximately 0.5 cm above and below the joint. The abscesses in the forelimb samples were then excised and studied separately; the remainder of the left forelimb (i.e., with the abscess removed) is referred to as the "inflamed-limb tissue sample." All samples were counted in an automated Searle Radiographics well counter using the 93-keV ^{67}Ga photopeak or the 279-keV ^{203}Pb photopeak. Duplicates of the injected dose, appropriately diluted, were used as standards.

The rats in Groups 3 and 4, designated as scanning animals, received an injection of 1 mCi of ^{67}Ga and 1 mCi of ^{203}Pb, respectively, into the tail vein at the same time that the first two groups of rats were injected. Two rats from Groups 3 and 4 were scanned and killed at 24 hr for inclusion in the data; the remaining two rats from these groups were scanned and killed at 72 hr. Scanning was performed with a Searle Radiographics Pho/Gamma HP scintillation camera and pinhole collimator.

In order to compare the uptake of gallium with that of lead in inflamed tissue, the background activity of the normal opposite limb (% dose/gm) was subtracted from that of the inflamed left limb. (Recall that the activity of the inflamed limb does not include activity in the abscess samples.) Ratios of activity in the inflamed tissue to that in other tissues were then calculated.

Statistical analysis of the data was performed using the paired Student's t-test.

TABLE 1. TISSUE CONCENTRATION OF ^{203}Pb IN CONTROL RATS AT VARIOUS TIMES*

Tissue	Concentration of ^{203}Pb (100 × % ID/gm)				
	4 hr	24 hr	48 hr	72 hr	96 hr
Blood	160 ± 20	53 ± 16	24 ± 3.6	15 ± 5.5	8.3 ± 0.7
Liver	150 ± 30	84 ± 4.9	25 ± 3.3	24 ± 10	15 ± 4.2
Kidney	1,100 ± 90	600 ± 200	310 ± 23	270 ± 35	230 ± 25
Small intestine	41 ± 5.8	17 ± 2.8	5.7 ± 1.8	3.8 ± 2.0	3.6 ± 1.7
Colon	41 ± 6.3	28 ± 2.4	10 ± 1.7	6.9 ± 2.6	6.3 ± 1.6
Muscle	1.7 ± 0.1	0.9 ± 0.08	0.46 ± 0.03	0.4 ± 0.1	0.51 ± 0.05
Right elbow	21 ± 3.9	33 ± 9.5	34 ± 3.5	41 ± 8.0	49 ± 9.3

* Expressed as 100 times the percent injected dose per gram ± 1 s.d. Each data point is based on the results from five rats.

TABLE 2. TISSUE CONCENTRATIONS OF ^{67}Ga AND ^{203}Pb AT 24 AND 72 HR IN RATS WITH AN ABSCESSED LEFT FORELIMB*

Tissue	24 hr		72 hr	
	^{67}Ga	^{203}Pb	^{67}Ga	^{203}Pb
Blood	27 ± 10	22 ± 8.7	3.5 ± 0.8	10 ± 4.1
Liver	100 ± 16	83 ± 21	110 ± 22	22 ± 8.1
Kidney	80 ± 32	220 ± 100	76 ± 22	140 ± 55
Muscle	6.5 ± 2.9	0.88 ± 0.18	6.5 ± 3.9	0.72 ± 0.20
Right forelimb	14 ± 3.2	18 ± 4.9	12 ± 2.5	20 ± 5.1
Left forelimb†	81 ± 28	71 ± 21	98 ± 35	46 ± 32
Abscess	110 ± 83	11 ± 5.2	60 ± 21	5.3 ± 2.7

* Expressed as 100 times the percent injected dose per gram ± 1 s.d. Data points represent the mean of ten rats.
† Data for the left forelimb does not include the abscess.

RESULTS

The ^{203}Pb distribution data for control rats are presented in Table 1. By 96 hr, approximately 25% of the injected dose was excreted. Roughly 7% of the total dose was excreted by the kidneys, with the remaining 18% in the feces.

At 24 hr, slightly more gallium than lead had accumulated in the inflamed left forelimb (Table 2), but the difference was not statistically significant until 72 hr, when gallium accumulation was twice that of lead ($p \leq 0.005$). The abscess samples had concentrated significantly more gallium by 24 hr than muscle, right forelimb, and blood ($p \leq 0.05$); gallium concentration in abscess was also higher than in the remaining tissues but the difference was not significant.

In contrast, lead concentration in the abscess samples was significantly less ($p \leq 0.01$) at 24 hr than in all other tissues except muscle (Table 2). In fact, the mean gallium concentration in abscess was 10 times that of lead at 24 hr and 12 times that of lead at 72 hr (Table 2). Furthermore, abscess-to-tissue ratios (% dose/gram) were significantly greater ($p \leq 0.05$) for gallium than for lead at both 24 and 72 hr for every tissue examined except muscle (Table 3). With both agents, the abscessed left forelimb could be easily identified by scanning at both 24 and 72 hr (Figs. 1 and 2).

TABLE 3. ABSCESS-TO-TISSUE ACTIVITY RATIOS FOR ^{67}Ga AND ^{203}Pb

Tissue	24 hr		72 hr	
	^{67}Ga	^{203}Pb	^{67}Ga	^{203}Pb
Liver	1.1	0.2	0.6	0.2
Kidney	1.5	0.1	0.9	0.1
Muscle	22.5	14.8	12.3	7.0
Right forelimb	8.6	0.7	5.3	0.5
Blood	4.6	0.8	17.6	0.6

DISCUSSION

Lead activity in the liver was 10–20% of the administered dose at 4 hr and decreased steadily thereafter. This decrease, coupled with the appearance of 10–15% of the administered dose in the feces by 48 hr, might be explained by hepatocyte uptake of lead followed by secretion into the bile. This postulated mechanism would indicate some degree of enterohepatic circulation of lead since 8–12% of orally ingested lead may be absorbed (7). An alternative or supplementary explanation may be direct secretion of lead into the gut lumen by the bowel wall; this mechanism has been shown to account in part for the fecal excretion of parenterally administered pertechnetate (*8*). The gastrointestinal tract was three times as effective as the kidneys in eliminating tracer amounts of lead.

The mechanism of gallium accumulation in inflammatory lesions has not been clearly defined (*9,10*). Gelrud et al. studied gallium concentration in experimental staphylococcal infections as a function of the age of the infection (*11*). In a similar but more extensive study, Blair et al. evaluated gallium accumulation in rats with experimental staphylococcal abscess at 6, 9, 12, 15, and 24 days after injection of the staphylococci (*12*). Injecting the nuclide 72 hr before counting, they found gallium concentration in the abscess contents to be relatively constant throughout the study. Since the age of a suspected abscess may not be known, we preferred to study gallium and lead accumulation in experimental staphylococcal abscesses as a function of time after radiopharmaceutical administration and not as a function of abscess age. Consequently, all the rats in our study received their gallium and lead injections 6 days after the second injection of staphylococci and were studied either 24 or 72 hr later.

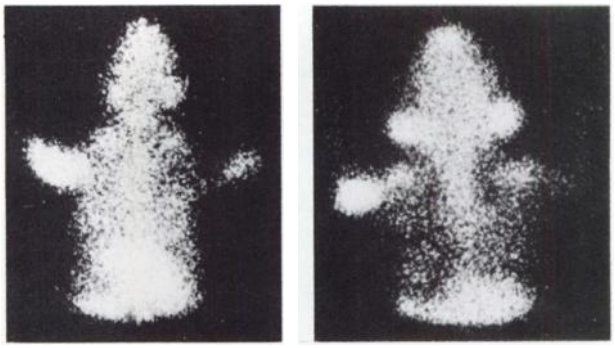

FIG. 1. Pinhole-collimator image showing ^{67}Ga uptake in abscessed left forelimb of rat at 24 (left) and 72 hr (right).

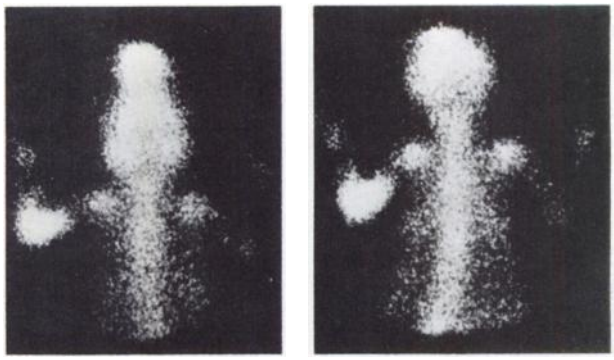

FIG. 2. Pinhole-collimator image showing ^{203}Pb uptake in abscessed left forelimb of rat at 24 (left) and 72 hr (right).

With the exception of blood, the abscess-to-tissue ratios appeared to be higher at 24 than 72 hr, but the differences were not statistically significant at the 0.05 level. The important point to note, however, is that the ratios were certainly not less. Based on these findings, if an abscess could be identified by scanning at 72 hr, it should in general be possible to identify it by scanning at 24 hr or possibly earlier. The successful localization of abscess 4 hr after gallium injection has, in fact, been reported (*3,13*).

Occasionally an abscess is identified at 72 hr when it was not apparent on an early scan. This observation may result from accumulation of gallium in the inflammed tissues surrounding the abscess. When the ratios of the inflamed limb (excluding the abscess and with background activity of the opposite limb subtracted) to other tissues are calculated, the results indicate a slightly higher ratio relative to kidney and muscle and a significantly higher ratio ($p \leq 0.001$) relative to blood at 72 hr than at 24 hr (Table 4). Consequently, inflammation, infection without abscess, and possibly osteomyelitis might be better identified on a 72-hr gallium scan. In practice, when abscess or infection is suspected, it is probably wise to scan both early and late.

TABLE 4. RATIOS OF ^{67}Ga AND ^{203}Pb ACTIVITY IN INFLAMED LIMB TO THAT IN OTHER TISSUES*

	24 hr		72 hr	
Tissue	^{67}Ga	^{203}Pb	^{67}Ga	^{203}Pb
Liver	0.8	0.9	0.8	1.8
Kidney	1.1	0.5	1.3	0.6
Muscle	16.1	82.1	20.5	79.8
Blood	2.8	4.2	27.8	5.7

* Activity in the abscess was not included in the activity of the inflamed left forelimb. Also, the activity in the normal right forelimb was subtracted from that in the left in order to correct for background. Each data point represents the mean for ten rats.

Lead-203 concentration in the abscess was much less than that of gallium but, like gallium, the lead concentration decreased by approximately 50% from 24 to 72 hr. Lead concentration in normal muscle was much less than that of gallium, and consequently the inflamed-left-forelimb-to-muscle ratios (Table 4) were significantly higher for lead than for gallium at both 24 and 72 hr ($p \leq 0.001$). This observation probably explains why the abscesses could be visualized so clearly in the lead scans (Fig. 2). However, for general purposes, ^{67}Ga-citrate appears to be a better agent for localizing abscess than ^{203}Pb-acetate.

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REFERENCES

1. HARVEY SC: Heavy metals. In *The Pharmacological Basis of Therapeutics*. New York, Macmillan, 1970, pp 977–982

2. HAGAN P, CHAUNCEY D, AYRES P, et al.: Viable and non-viable tumor incorporation of Pb-203 and ^{75}selenomethionine. *J Nucl Med* 16: 532, 1975

3. LITTENBERG RL, TAKETA RM, ALAZRAKI NP, et al.: Gallium-67 for localization of septic lesions. *Ann Intern Med* 79: 403–406, 1973

4. DAMRON JR, BEIHN RM, SELBY JB, et al.: Gallium–technetium subtraction scanning for the localization of subphrenic abscess. *Radiology* 113: 117–122, 1974

5. DELAND FH, BEIHN RM, SIMMONS GH, et al.: Enhanced tumor detection by gallium subtraction techniques. *J Nucl Med* 16: 523, 1975

6. HURWITZ SR, HAGAN PL, ALAZRAKI NP: Distribution of ^{67}Ga following intravenous administration: Effects of disodium edetate therapy. *J Nucl Med* 16: 280–283, 1975

7. KEHOE RA, THAMANN F, CHOLAK J: On the normal absorption and excretion of lead. II. Lead absorption and lead excretion in modern American life. *J Ind Hyg* 15: 273–288, 1933

8. TAYLOR A, HENRY J, ALAZRAKI NP: Intestinal concentration of ^{99m}Tc-pertechnetate into isolated loops of rat bowel. *J Nucl Med* 16: 470–472, 1976

9. SWARTZENDRUBER DC, NELSON B, HAYES RL: Gallium-67 localization in lysosomal-like granules of leukemic and nonleukemic murine tissues. *J Natl Cancer Inst* 46: 941–952, 1971

10. BURLESON RL, JOHNSON MC, HEAD H: In vitro and in vivo labeling of rabbit blood leukocytes with ^{67}Ga-citrate. *J Nucl Med* 15: 98–101, 1974

11. GELRUD LG, ARSENEAR JC, MILDER MS, et al.: The kinetics of ^{67}gallium incorporation into inflammatory lesions: Experimental and clinical studies. *J Lab Clin Med* 83: 489–495, 1974

12. BLAIR DC, CARROLL M, CARR EA, et al.: ^{67}Ga citrate for scanning experimental staphylococcal abscesses. *J Nucl Med* 14: 99–102, 1973

13. HOPKINS GB, KAN M, MENDE CW: Early ^{67}Ga scintigraphy for the localization of abdominal abscesses. *J Nucl Med* 16: 990–992, 1975

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