JJ, Griffiths E, eds. *Iron and infection.* New York: John Wiley & Sons Ltd; 1987:171–209.
9. Weinberg ED. Iron and infection. *Microbiol Rev* 1978;42:45–66.
10. Tabak L, Mandel ID, Karlan D, Baurmash H. Alterations in lactoferrin in salivary gland disease. *J Dent Res* 1978;57:43–47.
11. LaForce LM, Boose DS. Release of lactoferrin by polymorphonuclear leukocytes after aerosol challenge with escherichia coli. *Inf Immunol* 1987; 55:2293–2295.

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REPLY: We are happy to share additional data with the nuclear medicine community from our study on the cellular basis for the elevated ^{67}Ga computed lung index in a rheumatoid patient. A two-tailed t-test was performed using the three variables: cell type, incubation time and transferrin (TF) presence or absence in 20 combinations. The pertinent data combinations are seen in the accompanying tables of P values. The 42-hr incubation culture data are shown in Table 1, where different TF states of either the same cell type or different cell types are compared. The p values for 22 of the 25 possible combinations range from 0.001 to 0.053. This indicates that most of these data are significant. When considering only TF+ cells incubated for 42 hr, comparisons between neutrophils, monocytes, resting lymphocytes, plasmocytes #1 and plasmocytes #2 gave p values ranging from 0.001 to 0.030 (not illustrated). The only exception was when plasmocytes #1 and #2 were compared, which gave a p value of 0.622 as expected.

The 18-hr culture data are shown in Tables 2 and 3. When considering only TF+ cells of different cell types, five of six possible combinations gave significant P values (Table 2). When considering different cell types that had different TF states, 9 of 12 possible combinations gave significant P values (Table 3). When considering different TF states for the same cell type, the p values ranged from 0.146 to 0.206 (Table 3). Technical and kinetic differences are the reasons for this occurrence. Statistical analysis of our 18-hr incubation culture data shows that some of the observations published in our case report on the effects of apotransferrin may need to be reconsidered. In summary, statistical analysis of the culture data supports the conclusion that both plasmocytes and activated lymphocytes are responsible for the radiogallium uptake in rheumatoid lung.

With regard to the use of human TF, our Materials and Methods section did specify that we added human TF to the culture milieu in addition to fetal calf serum. Fetal calf serum has been used before as a relatively nontransferrin-stimulatory general growth additive to culture media when transferrin-effect experiments are performed (*1,2*). From the work of Harris et al. (*2*), it would *not* be "expected that the addition of transferrin would have minimal effect (at low concentration 20 μg/ml) on ^{67}Ga uptake in all cell types except activated lymphocytes." They showed that this low concentration promoted optimal uptake of radioiron in mouse myeloma cells after which increasing concentrations of transferrin led to a decline in radioiron uptake and a plateau in radiogallium uptake. They also showed that apotransferrin had the maximal effect by demonstrating a declining radiogallium uptake with increasing iron loading of the apotransferrin (*2*).

With regard to the role of lactoferrin (LF), we should state that the experimental data in most publications, including Dr. Weiner's later paper (*3*), deal primarily with cellular uptake of radiogallium, not extracellular-based LF uptake of radiogallium. The exception is the work of Tsan (*4*). In contrast to his work with bacterially and chemically induced rabbit thigh abscesses, significant extracellular LF is unlikely to be present in our case of rheumatoid lung because this disease is a chronic proliferative inflammation, not an exudative inflammation. It appears that only sequestered lactoferrin (contained in a walled-off abscess) would resist removal by tissue vasculature, especially in the lung with its rich vasculature.

TABLE 1
Statistical Comparisons of the Influence of Human Transferrin Absence and Presence at 2 mg/ml with 35% Iron Saturation on ^{67}Ga Uptake in Cultures of Different Types of Leukocytes at 42-Hr Incubation

	Tf+				
Tf−	Polys	Monos	Rest lymph	Plasm #1	Plasm #2
Polys	0.001	0.001	0.001	0.001	0.001
Monos	0.005	0.006	0.004	0.004	0.004
Rest lymph	0.005	0.006	0.002	0.002	0.002
Plasm #1	0.015	0.006	0.374	0.001	0.004
Plasm #2	0.137	0.042	0.511	0.082	0.053

TABLE 2
Statistical Comparisons of ^{67}Ga Uptake in Different Types of Leukocytes Cultured for 18 Hours in the Presence of Human Transferrin at 20 μg/ml with 0% Iron Saturation

	18-hr incubation			
18-hr incubation	Polys	Monos	Resting lymph	Activated lymph
Polys	—	0.020	0.002	0.008
Monos	0.020	—	0.061	0.252
Resting lymph	0.002	0.061	—	0.024
Activated lymph	0.008	0.252	0.024	—

TABLE 3
Statistical Comparisons of the Influence of Human Transferrin Absence and Presence at 20 μg/ml with 0% Iron Saturation on ^{67}Ga Uptake in Cultures of Different Types of Leukocytes at 18-Hr Incubation

	Tf+			
Tf−	Polys	Monos	Resting lymph	Activated lymph
Polys	0.150	0.062	0.062	0.089
Monos	0.003	0.146	0.021	0.029
Resting lymph	0.006	0.041	0.154	0.000
Activated lymph	0.069	0.124	0.087	0.206

Additional correlative data show that cell-bound radiogallium is likely to be responsible for elevated computer lung indices in rheumatoid lung. These data come from an additional rheumatoid lung case that we encountered, which had a ^{67}Ga computed lung index of only 110 when compared to the index of 308 in the published case. The open lung biopsy microscopic sections from this additional case exhibited much less chronic inflammatory infiltrate than that which occurred in the published case. As in the published case, neutrophils were almost nonexistent.

Our interpretation of our culture findings incorporates Dr. Weiner's original suggestion that LF contained in the cytoplasm of neutrophils is a major site for radiogallium accumulation (*3*). Radiogallium scintigraphy is usually performed at 48 hr, at which time one images the "repository" not the receptors. Our experiments were not designed as the minute-range, receptor-uptake type. They reflect in vivo clinical imaging because radiogallium was present with the cells during both of the entire incubation periods. Our experiments were patterned after the Australian researchers' earlier work, in which they specifically performed long-term rather than short-term incubations (*1,2*). In the Australian researchers' macrophage mutation paper (*5*), they returned to the use of short-term incubation receptor type work. Since the binding affinity of LF is greater than that of TF (*6*), the transfer of iron or gallium from TF to LF could be an intracellular phenomenon and does not necessarily need to involve LF receptors.

If extracellular LF due to bronchial hyperactivity was the cause of the excessive radiogallium uptake in our rheumatoid lung patient, then we should have seen a hilar and perihilar concentration of radiogallium in the scintigrams. This was not the case; the uptake was peripheral and homogenous. Furthermore, human studies have shown that radiogallium recovered from bronchoalveolar lavage is essentially all cell bound (*7*). Also, the results of challenge with aerosolized *E. coli* do not mimic the situation with regard to rheumatoid lung. We hope that the data and discussion provided herein will give the nuclear medicine community greater insight into the considerations necessary to understand gallium uptake.

REFERENCES

1. Sephton RG, Harris AW. Brief communication: gallium-67 citrate uptake by cultured tumor cells, stimulated by serum transferrin. *J Natl Cancer Inst* 1974;54:1263–1266.
2. Harris AW, Sephton RG. Transferrin promotion of gallium-67 and iron-59 uptake by cultured mouse myeloma cells. *Cancer Res* 1977;37:3634–3638.
3. Weiner R, Hoffer PB, Thakur ML. Lactoferrin: its role as a gallium-67 binding protein in polymorphonuclear leukocytes. *J Nucl Med* 1981;22:32–37.
4. Tsan M-F, Chen WY, Scheffel U, Wagner HN. Studies on gallium accumulation in inflammatory lesions: I. Gallium uptake by human polymorphonuclear leukocytes. *J Nucl Med* 1978;19:36–43.
5. Andreesen R, Sephton RG, Gadd S, Atkins RC, De Abrew S. Human macrophage maturation in vitro: expression of functional transferrin binding sites of high affinity. *Blut* 1988;57:77–83.
6. Hoffer PB, Huberty J, Khayam-Bashi H. The association of gallium-67 and lactoferrin. *J Nucl Med* 1977;18:713–717.
7. Hunninghake GW, Line BR, Szapiel SV, Crystal RF. Activation of inflammatory cells increases the localization of gallium-67 at sites of disease. *Clin Res* 1981;29:171A

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Ventilation-Perfusion Lung Scans

TO THE EDITOR: Pulmonary physiologists have traditionally used V as the symbol for a volume of gas and $\dot{V}$ as the symbol for gaseous flow rate. Similarly Q is the symbol for a volume of blood and $\dot{Q}$ is the symbol for blood flow rate. V/Q and $\dot{V}/\dot{Q}$ are ratios of these measurements (*1*).

Some years ago (*2*) the distribution of radioactivity in a ventilation-perfusion lung scan was abbreviated erroneously to V/Q despite the fact that neither blood volume nor blood flow was quantified. This abbreviation caught on and has persisted in many centers.

In the recent paper by Klingensmith and Holt (*3*), ventilation-perfusion lung scans are abbreviated to $\dot{V}/\dot{P}$, as if ventilation and perfusion were quantitated, while Gottschalk in his accompanying editorial (*4*) further compounds the error by using the symbols $\dot{V}/\dot{Q}$.

Until we actually measure ventilation ($\dot{V}$) and perfusion ($\dot{Q}$) why not call a lung scan what it is—a V-P scan?

REFERENCES

1. West JB, ed. *Best and Taylor's physiological basis of medical practice,* 11th edition. Baltimore, MD: Williams & Wilkins; 1984.
2. McNeil BJ. Ventilation-perfusion studies in the diagnosis of pulmonary embolism. *J Nucl Med* 1980;21:319–323.
3. Klingensmith WC, Holt SA. Lung scan interpretation: a physiologic, user-friendly approach. *J Nucl Med* 1992;33:1417–1422.
4. Gottschalk A. Editorial: lung scan interpretation: a physiologic, user-friendly approach. *J Nucl Med* 1992;33:1422–1424.

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REPLY: Dr. Fishman raises some interesting and valid points. I remind him, however, that nuclear medicine is not only physiologically oriented, but, among other things, radiochemically oriented as well. Do we want the Mike Welch's of our world to think we speak of vanadium-phosphorus scanning? It may be that the "correct" application of jargon works better in a narrow specialty rather than a multidisciplinary area such as nuclear medicine, where much overlap exists and conventional slang may be more easily understood than precise application of terms. For instance, the xenon-133 study starts with a single breathhold which is proportional to flow rate and thus $\dot{V}$ could be used. The next step (equilibrium) is proportional to aerated lung volume (V), and the washout is dependent on the degree of collateral air drift; let's call it SW, for slow washout. So, why not call the ($\dot{V}$, V, SW) - P scan?

Personally, I prefer and use the term V/Q scanning *without* the dots above the letters. The dots appeared in the editorial process, which I assumed was *JNM* policy. I use V/Q from a long-standing bias, getting firmer as I grow older, that language is best used to communicate. As Dr. Fishman put it, V/Q is "the abbreviation that caught on." So far, when I use V/Q, people understand what I mean.