Rapid determination of oxidation state of unbound <sup>00m</sup>Tc and labeling yield in <sup>10m</sup>Tc labeled radiopharmaceuticals. J Nucl Med 17: 805-809, 1976

#### Prominent Motion of a Meckel's Diverticulum

Abdominal scintigraphy with sodium pertechnetate is a useful clinical screening test for the presence of a Meckel's diverticulum (1). In the usual procedure, the patient is imaged in the fasting state and serial images are obtained (2,3). On a positive scan, a Meckel's diverticulum usually appears as a stationary focus of activity that accumulates at the same rate as gastric activity. Occasionally this abnormal focus of activity moves during the imaging procedure (3). This communication describes the findings in a patient with a Meckel's diverticulum that showed prominent motion during imaging.

The patient was an 18-month-old male with a history of intestinal bleeding. After an 8-hr fast, 1 mCi Na<sup>00m</sup>TcO<sub>4</sub> was given intravenously. Serial images of the abdomen were obtained with computer-assisted gamma camera systems. An acquisition time of 10 min was used for each of the first three images. When a changing pattern of activity became apparent, the imaging time was shortened to 5 min for two images and to 2 min for one image.

The serial images showed a single focus of abnormal activity in the abdomen, moving from the left lower quadrant to the extreme right lower quadrant during the imaging procedure (Fig. 1). This motion caused double exposures of the abnormal activity in three of six images obtained in 42 min. The patient did not move significantly during this period. The images were therefore interpreted as showing a Meckel's diverticulum with motion due to intestinal peristalsis. Subsequently surgical removal and pathologic examination confirmed the presence of a large ulcerated Meckel's diverticulum.

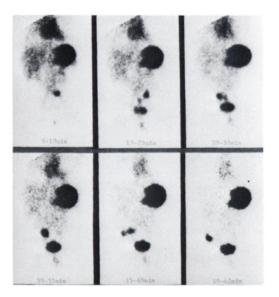


FIG. 1. Pertechnetate scintigrams in an 18-month-old male showing four discrete sites occupied by a Meckel's diverticulum that was subsequently confirmed at surgery. The images with two abnormal foci of activity resulted when the single abnormal focus in the diverticulum made a sudden transition from one site to another during the imaging period.

The interesting feature of this case was the prominent motion of the Meckel's diverticulum throughout the imaging procedure. Observation of the persistence scope during imaging helped to prevent confusion in the interpretation of the resulting images. As an image with a double exposure of the diverticulum activity was acquired, the first abnormal focus of activity suddenly stopped accumulating counts when the second abnormal focus appeared. These sudden transitions of the abnormal activity between four discrete sites in 42 min were thought to be most compatible with motion of a Meckel's diverticulum by intestinal peristalsis. In retrospect, shorter imaging times would have reduced the probability of double exposure of the Meckel's diverticulum without unduly reducing image quality.

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# Rating of the Radiopharmaceuticals for Brain Imaging

In recent years, Haynie et al. (1,2) have compared the biologic behavior of a number of radiopharmaceuticals in an animal brain-tumor model, employing a rating system that they expounded in their first paper (1). Without undermining the importance of their well-planned, well-thoughtout, and well-executed experiments, I wish to point out some of the shortcomings of this rating system. The authors are aware of some of the important shortcomings, such as the lack of tumor-to-bone ratios, which were therefore excluded from the rating system. My purpose is not to dwell on these, but to draw attention to those that are intrinsic in the rating system itself.

- 1. All of their measurements are quantitative, yet in their rating system, they have converted these quantitative observations into a qualitative rank order. As a result, one can only say, for example, that Agent A is better than B, but cannot specify how much better. It may be slightly better or it may be infinitely superior. In mathematical terms, an interval scale has been reduced to an ordinal scale (3) with the concomitant loss of the quantitativeness in the rating system.
- 2. Four of these qualitative parameters (grades for % administered dose/g, and tumor-to-brain, tumor-to-blood, and tumor-to-skin ratios) have been combined together with equal emphasis. Since, in two-dimensional scanning, one more or less sums the counts arising from different depths in an organ, more counts are contributed to a brain scan by the radioactivity present in the brain and blood than by the radioactivity present in the skin. Therefore, tumor-to-skin ratios should not be used with the same emphasis as the tumor-to-brain and tumor-to-blood ratios. Also, I am not sure whether the % administered dose/g belongs in this rating system at all. Since this parameter bears primarily on

the amount of time one will have to spend scanning, or the amount of radioactivity that one will have to administer, it relates more to radiation dose considerations than to biologic considerations. The authors have excluded the radiation dose considerations from their rating system. Therefore, this parameter should be excluded as well.

Because of these drawbacks, it is difficult to imagine what, if anything at all, their rating system represents. To prove my point, let us consider two hypothetical agents, A and B, with the following experimental data for the four components used in their rating system:

Agent	% ad. dose per gram	Tumor- to-brain	Tumor- to-blood	Tumor- to-skin
В	3	3	3	2

According to their rating system, both agents should be rated equal, whereas with such high tumor-to-brain and tumor-to-blood ratios, and with only slightly inferior % administered dose/g and tumor-to-skin ratios, Agent A will be a far better choice than Agent B.

This fundamental weakness of their rating system is also evident in their radiopharmaceutical rankings. I am reproducing experimental data for the 4th ranked (one of the best) and 15th ranked (one of the worst) radiopharmaceuticals from Table 1 of their first paper (1).

	% ad. dose per gram	Tumor- to-brain	Tumor- to-blood	Tumor- to-skin
4th rank	3.04	6.8	0.25	1.13
15th rank	2.80	6.6	0.21	0.56

A glance at the data makes it clear that there is not a large difference between a good and a bad agent. The differences in the first three pairs of numbers are probably statistically insignificant. The only numbers that seem different are the tumor-to-skin ratios, which alone have pushed one to 4th place and the other to 15th place. Incidentally, when these authors used their experimental results in the rating system, they completely ignored the statistical significance of the differences between the measurements. Consequently, a tumor-to-blood ratio of 0.21 rated better than one of 0.19. Due to the want of the standard deviation data in their papers, I am unable to make a definite statement as to whether these two numbers are statistically different, but, from my own experience, it seems highly unlikely.

In conclusion, I feel there is a vital need for a suitable biologic parameter (figure of merit) with which to compare different radiopharmaceuticals in an experimental model system for brain scanning. I do not think, however, that the parameter used by Haynie et al. meets the desired need.

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#### Reply

The letter of Dr. Chandra concerning "Rating of Radiopharmaceuticals for Brain Imaging" is acknowledged with thanks, since it stresses problems encountered by every investigator who attempts to study tumor-localizing agents. We respond not to justify the defects in our rating system but rather to emphasize again our previous admonition that these data should not be translated into the clinical sphere without due caution.

Point 1 in Dr. Chandra's letter is well taken. The rating system does not provide an index of how agents differ or how much they differ. From inspection it is apparent that some are quite close, others quite different in their values. In our previous papers we have provided figures for statistical significance. We did not think it appropriate in the rating system, which was more an attempt at "optimization" than at judging differences.

With regard to point 2, we cannot agree with Dr. Chandra that the percentage administered dose per gram of tumor does not belong in the rating system. It certainly is a measure of the avidity of the tumor for the substance. Limitations on available scanning time and radioactivity that can be administered also make this of importance. We do recognize that some rapidly excreted agents may achieve good ratios with low percentage uptake per gram. It is for this reason that we now also use percentage retained dose/g tumor as an alternate means of evaluation (1,2). We agree that tumorto-skin ratios are not an entirely satisfactory substitute for "calvarial" contribution, but technical difficulty with this model confined us to this. The proximity of the calvarium to the detector, however, leads us to believe that its contribution to count rate makes it of considerable importance. Dr. Chandra's hypothetical case will be of importance if we ever encounter an agent with the bizarre characteristics that he postulates.

Among our suggestions for future developments has been the need for comparisons between existing tumor models and the results obtained in humans, in order to understand better the relationship between animal and human tumors (3). It should be our goal in laboratory research with tumor models to indicate to clinicians those trends and phenomena that can be observed repeatedly and that may be applicable to a better understanding of malignant disease in man. As Dr. Chandra points out, we have a long way to go.

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## Dry Aerosol Delivery System Compared with Ultrasonic Nebulizer

We have previously described a compressed-air system to