sensitivity caused by reduced scanning time must result in the reduced statistical significance of abnormal areas.

Such reduction in significance may not always be immediately apparent. For example, an abnormality of 20 standard deviations (s.d.) significance would be reduced to one of 10 s.d. by a fourfold reduction in scanning time—still a highly significant abnormality. However, a 5 s.d. abnormality would be reduced to 2.5 s.d. and would almost certainly be missed.

The authors also suggest that visual improvements in general can be obtained by minification. This may be true but it should not be used as an excuse for sacrificing statistical accuracy.

There is no doubt that reducing scanning time is important in improving patient management. If it can be shown that no abnormalities are missed by reducing sensitivity because, for example, abnormalities below a certain size and activity do not present clinically, then reducing scanning time may be permissible. Otherwise, scanning time ought not to be reduced without increases of sensitivity in other directions, e.g., increased administered activity or improvements in collimator design.

I wish to thank Dr. H. Miller, Dept. of Medical Physics, Sheffield, England, and Professor J. R. Mallard, Dept. of Medical Physics, Aberdeen, Scotland, for drawing my attention to this point.

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AUTHORS' REPLY

We entirely agree with Mr. Barber that minification cannot increase the information content of a scan. This claim was not made or implied anywhere in our paper. In fact, we stated that, "the limiting factor must be the information density per unit area scanned," and the title stated that we were proposing "a practical compromise" for bone scanning.

In the daily running of a busy clinical laboratory, as in most routine human endeavors, one must be primarily concerned with what is feasible. This often necessitates compromise with what would be ideally desirable; indeed, the ordinarily recommended information density of 100–200 counts/cm^2 for ^{85}Sr bone scanning is already a compromise. Scanning only localized areas of bone has limited clinical value. Since whole-body bone scanning with ^{85}Sr is not routinely feasible at the above information density, we therefore attempted to see whether: (A) the visual improvements gained by minification (*1*) could in practice reasonably compensate for decreased information with increased scan speed and (B) simple photography was an adequate way to achieve this minification. In our admittedly small series we did not, in fact, miss any of the 28 positive areas by this technique.

When ^{85}Sr still remains the only agent widely available for bone scanning, we believe our study suggests that whole-body bone scanning with miniturization is worthwhile when it might otherwise be quite impractical. The option of rescanning questionable and/or suspicious areas at a higher information density is still available.

Thus, while we completely agree with the theoretical considerations raised by Mr. Barber, we feel the philosophy implied is unnecessarily rigid when the practical alternatives are limited.

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QUALITY CONTROL OF RADIOHPARMACEUTICAL KITS

In the past year there has been a rapid proliferation of commercial kits for the on-site preparation of radiopharmaceuticals, especially those labeled with ^{99m}Tc. Even though this provides a greater variety of radiopharmaceuticals to the nuclear medicine clinician, it has put a new dimension on an old

problem in nuclear medicine—that of the chemical identity of the radiopharmaceutical which is injected into the patient. What is the labeling efficiency of a specific preparation? What other radioactive species are present?

Over the past six months we have evaluated several different radiopharmaceuticals that are being supplied in kit form by a number of different commercial suppliers. With each commercial kit we have found that, although the final product generally performs according to the manufacturer's specifications and has the correct chemical identity with only minimal radioactively labeled impurities, there was with each kit the odd case in which either the major radioactive chemical was not of the desired chemical identity or there was an undesirably large amount (greater than 30%) of radioactive impurity. If such a preparation was used on a patient, the best result that could be hoped for would be a poorer quality scan due to a lower counting rate over the desired organ with an unnecessarily large radiation dose being given to nontarget organs owing to the biological distribution of the impurity. It is not possible for the kit manufacturer to guarantee that the final radiopharmaceutical has the chemical identity and purity necessary. The manufacturer cannot guard against such problems as the incorrect order of mixing various ingredients, the presence of aluminum in the eluant of the generator, or the presence of excess oxidants in the eluant of the ^{99m}Tc generator. Therefore, the manufacturer cannot be expected to assume the full responsibility for the chemical nature and the efficacy of the final radiopharmaceuticals prepared from a kit. For this reason all radiopharmaceuticals that are partially or completely manufactured on site should be subjected to on-site quality control. It would be impractical to suggest that every hospital which uses kits should set up elaborate testing procedures to check out every detail of the chemical nature of every radiopharmaceutical. If such were required, kits would be of no value. However, it is possible to perform useful tests on nearly all presently available kit-type compounds with very simple, inexpensive equipment and minimal experience. The kit manufacturer should therefore be encouraged to include recommended methods for the convenient and practical quality control of the final radiopharmaceutical with their product descriptions.

In our laboratory we have found that one useful quality control system is thin layer and/or paper chromatography. This type of quality control can be performed in less than 1 hr, requires very little actual technician time, and is an accurate system if the correct choice of solvent(s) and paper or thin layer medium is made. In order to make this choice of solvent(s) and medium, it is necessary to know what the likely contaminants are, the R_f values of these contaminants, and the R_f values of the desired product for the various solvent(s) and mediums being considered. To obtain accurate quality control results it is necessary to separate the desired product from each of the likely contaminants. The lack of data on the various R_f values of the ^{99m}Tc products and contaminants is the principal obstacle to the accurate routine application of this technique to the quality control of radiopharmaceuticals.

Gutkowski and Dworkin (*1*) have reported the practical details of performing such a quality control procedure on ^{99m}Tc-sulphur colloid. Some laboratories have adopted this procedure for the quality control of other ^{99m}Tc radiopharmaceuticals using 85% of methanol as a solvent and either paper or silica gel as the thin-layer medium. However, Eckelman and Richards (*2*) have pointed out that this system fails to separate the products, ^{99m}Tc-serum albumin and ^{99m}Tc-diethylenetriaminepenta-acetic acid (DTPA) from the contaminant to which they refer as "hydrolysed reduced technetium". In their article (*2*), Eckelman and Richards recommend the use of paper chromatography with saline as the solvent to analyze the contaminants in ^{99m}Tc-serum albumin and ^{99m}Tc-DTPA. They also reported the R_f values for ^{99m}Tc-pertechnetate, ^{99m}Tc-HSA, ^{99m}Tc-DTPA, and "hydrolysed reduced ^{99m}Tc" using paper chromatography with both saline and 85% methanol as solvents. It should be emphasized that the paper chromatography/saline system must be handled carefully because the R_f values, as reported by Eckelman and Richards, are relatively close, and good technique is necessary to obtain a satisfactory separation of the pertechnetate and the serum albumin or DTPA. Thus, it is evident that more data on alternative systems that are less critically dependent on technique would be most useful to potential users of on-site produced radiopharmaceuticals.

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