Correct Use of Dose Calibrator Values

TO THE EDITOR: In a recent article by Salako and DeNardo (*1*) the authors discussed the relative accuracy of two recommended dose calibrator settings for assaying solutions of ^{90}Y using a commercially available dose calibrator. The first setting, "775 × 100," is recommended by Capintec, Inc. (Pittsburgh, PA) (*2*) for measuring ^{90}Y in a standard National Institute of Standards and Technology (NIST)-style 5-ml glass ampoule. This setting was known to result in inaccurate assays, which prompted the second calibration factor, "48 × 10," to be experimentally determined by Coursey et al. (*3*) in the same sample geometry with direct determination of the solution activity using several detection methods. In the present article (*1*) the authors attempt to arrive at a multiplicative factor that would somehow salvage the erroneous "775" setting, recommending a calibration factor of "775 × 70."

While it is laudable that these workers recognize the importance of using the correct dose calibrator setting, we feel that there are several points that need to be clarified:

1. Dose calibrator settings depend strongly on the geometry of the sample, especially for low-energy photon emitters. The calibrator settings recommended by most dose calibrator manufacturers are valid only for the standard NIST geometry; that is, a 5-ml flame-sealed, thin-walled glass ampoule. Radiopharmaceuticals are usually shipped from the manufacturer in vials or single-dose plastic syringes, both of which have different photon absorption characteristics than the geometry for which the calibration factor was determined. The result is that a discrepancy of 10% or more can be observed if the incorrect calibration factor is applied for a particular geometry. It is imperative that the correct calibration factor be applied for the particular container used in the radioassay.
2. The dose calibrator is sensitive not only to the type of container used but also to the filling volume of solution in the container. This effect is clearly seen in the glass vial data presented in Table 3 from Salako and DeNardo's article (*1*). As the vial is filled, the apparent activity appears to decrease. This is most likely due to photon absorption by the source liquid, leading to a lower response in the dose calibrator.
3. The multiplicative factor applied to calibration factors that fall outside the normal operational range of the instrument potentiometer (such as "48 × 10," "775 × 100," etc.) are usually chosen so as to provide a convenient way to calculate the activity from the dose calibrator display. One can easily find any combination of dial settings and multiplicative factors that can give the correct activity, and they would all be equally appropriate. However, most people find it easier to multiply or divide multiples of 10. Therefore, despite the fact that Salako and DeNardo (*1*) have apparently determined a multiplicative factor for the "775" setting that will provide the correct activity, we still recommend the use of the "48 × 10" setting for ^{90}Y on the basis of ease of use.
4. The experimental design of the study was somewhat flawed in that one of the aims as outlined in the beginning of the article was to investigate the variability of shipments of ^{90}Y using a dose calibrator. The correct approach to the problem should have been to first determine the calibration factor using a standardized source of ^{90}Y. After establishing the correct setting, the sources could then have been assayed. As for the liquid scintillation measurements, it is not known why the author's liquid scintillation activity measurements differed from the manufacturer's value by about 12%, but relying on the manufacturer's stated activity only introduced an additional uncertainty. A better approach would have been to trace the activities of the manufacturer's shipments against a standardized sample of ^{90}Y.

In summary, it should be kept in mind that dose calibrators are extremely useful and reliable instruments as long as the correct calibration factor is applied for the radionuclide of interest in the geometry for which the calibration factor was determined. When attempting to determine a new calibration factor, it is imperative that a standardized solution of the radionuclide be used for all measurements.

REFERENCES

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REPLY: We acknowledge the interest of Drs. Zimmerman, Coursey and Cessna in our article on radioassay of ^{90}Y by radionuclide calibrator (*1*). Our work was actually a follow-up to that of Coursey et al. (*2*) in accordance with their experimental plan and recommendations. In their work, Coursey et al. (*2*) standardized a solution of ^{90}Y supply by a tritium-tracing method (*3*), then used standard solutions prepared from this by serial dilution to characterize radionuclide calibrators, liquid and solid scintillators, and Cerenkov counters. In consonant with their results, Coursey et al. (*2*) advised prospective ^{90}Y users that "alternatively, solutions may be standardized by liquid-scintillation counting using the method" they described, "and those working solutions may be used to calibrate the radionuclide calibrators." In our work (*1*), we prepared counting solutions (10 replicates) from a commercial sample of $^{90}YCl_3$ solution after the serial dilution technique of Coursey et al. (*2*), then established the radioactivity contents (MBq) in these test solutions by liquid scintillation counting (LSC) against tritium standards. Standard solutions were then prepared from the commercial $^{90}YCl_3$ solution and used to calibrate our radionuclide calibrator. Our results corroborated those of Coursey et al. (*2*) in terms of the right radionuclide calibrator dial setting for ^{90}Y calibration. Consequently, we regard the comments of Zimmerman et al., in their letter, as pertinent to the import of our message in the publication under reference *1*. The following are our respective reactions to their comments:

1. We support the statement on the importance of using the right calibration factor for radioassay of ^{90}Y, however, it is important to stress that calibration factors and container correction factors are not the same. Coursey et al. (*2*) re-established the appropriateness of calibrator dial setting 48 (with multiplicative factor 10) for measuring a ^{90}Y source contained in a thin-walled glass ampoule. We have also confirmed this same dial setting 48 × 10 as a correct calibration factor for calibrating ^{90}Y sources contained in 1-ml glass vials. The essential point might be to recommend a particular container (e.g., the thin-walled glass since the reference ^{90}Y source is contained in this) as a reference container to which other containers are related with appropriate container correction factors, but this we believe many ^{90}Y suppliers are doing already. Therefore, the statement of Zimmerman et al. that "it is imperative that the correct calibration factor be applied for the particular container used in the radioassay"