Modification of Mediac Dose Calibrator

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An inexpensive and simple method for expanding the versatility of a Mediac dose calibrator is described. The method is applicable to the newer gamma-emitting isotopes, such as \(^{67}\text{Ga}\), \(^{111}\text{In}\), or \(^{169}\text{Yb}\), which are of interest today in nuclear medicine.

The Mediac (Searle Radiographics, Inc.) dose calibrator has enjoyed wide use as a convenient and accurate instrument in clinical nuclear medicine. However, it lacks ready adaptability to new radionuclides. Typically, the substitution for a new radionuclide setting costs several hundred dollars for the service call modification and the procurement of accurately assayed standards of the isotope in question.

Materials and Methods

An inexpensive solution for the modification is to install on the isotope calibration circuit board a ten-turn precision variable resistor with a digital dial in place of a resistor for one of the no longer used isotope settings, and then calibrate this potentiometer for any isotope of interest. The resistors on the circuit board are clearly labeled according to isotope and the board is easily accessible (nearest to ionization chamber) after removing the outer cabinet of the Mediac. The isotope position chosen to be deleted was for \(^{203}\text{Hg}\). Thus a 41.2-k\(\Omega\) resistor, labeled R31 on the circuit board, was removed and replaced with wires run to jacks installed on the lower rear of the chassis. The variable resistor can then be mounted in a minibox and plugged into the chassis jacks. A 0.910-k\(\Omega\) resistor, R30, for the \(^{203}\text{Hg}\) position was left on the circuit board in series with the variable resistor as a current limiter. Figure 1 shows the circuit diagram. This is not an elegant construction method, but it is inexpensive, simple, and does not affect the structural integrity of the Mediac. A 0–500-k\(\Omega\) precision linear variable resistor (resistance \(\pm 3\%\), linearity \(\pm 3\%\)) is commercially available and covers the \(\Gamma\) range of isotopes shown in Fig. 2. The entire project (including potentiometer, ten-turn dial, and minibox) costs less than $50.

We observed empirically that a plot of \(\ln \Gamma\) versus \(\ln R\) is well fit by a linear function as shown in Fig. 2. Here \(\Gamma(\ )\) is in milliroentgens per millcurie per hour at 1 m and \(R\) is the value of the resistance in kilohms on the Mediac isotope calibration circuit board. The un-weighted least-squares straight line fit to the data of Fig. 2 is given by

\[
\ln R = 1.93 - 0.914 \ln \Gamma,
\]

with the linear correlation coefficient \(r > 0.99\); and reduced chi-squared, \(\chi^2 = 0.013\).

Thus, to determine the activity of any isotope not included on the Mediac isotope selector, it is only necessary to look up the \(\Gamma\) value, read the \(R\) value from Fig. 2, and set this value on the dial of the variable resistor. For a 500-k\(\Omega\) potentiometer (wired with \(R\) increasing clockwise) and a ten-turn dial which reads from 0 to 1000, the resistance desired is set by a dial reading of

\[
2(R - 0.910) \text{ R in kilohms.}
\]

The 0.910 arises from the current-limiting resistor left on the board as a safety factor. The unknown activity may then be measured on the modified isotope selector dial position. No attempt was made at a detailed assessment of the accuracy of this procedure since it is intended as a method for crudely and quickly checking the assay value provided by the manufacturer on radio-

![Fig. 1. Circuit diagram for Mediac modification. Resistors R30 and R31 are used in \(^{203}\text{Hg}\) selector switch position on isotope calibration circuit board in Mediac. Resistor R31 was removed and replaced by 0–500-k\(\Omega\) precision variable resistor as detailed in text.](image-url)
pharmaceuticals. However, by estimating the accuracy of the $\Gamma$ values at $\pm 10\%$ and also considering the errors in the resistance and linearity of the potentiometer, it is possible to make a conservative estimate that this procedure can determine activity to within $\pm 15\%$.

**Results and Discussion**

Table 1 shows some test cases where the $\Gamma$ value was used to calculate $R$, the potentiometer was simply dialed to the appropriate numbers, and the isotope activity was measured on both the modified isotope selector switch and on the switch position for the actual isotope. The results of the modified switch setting and the actual isotope switch setting agreed within the predicted $\pm 15\%$. This accuracy is sufficient for diagnostic nuclear medicine procedures. [A recent study (2) showed that commercial dose calibrators have accuracies in the range of 10–15%.] Note that whether the modified switch datum for any isotope is higher or lower than the actual isotope switch datum depends on whether the isotope lies to the left or to the right of the straight line fit in Fig. 2.

Table 2 shows the results of a comparison between the activity as stated on the radiopharmaceutical vial and the activity as measured on the dose calibrator using the modified isotope position with a resistance calculated from the $\Gamma$ values of $^{67}\text{Ga}$ (1), $^{111}\text{In}$ (3), and $^{169}\text{Yb}$ (4). This comparison assumes the correctness of the radiopharmaceutical manufacturer's calibration. No attempt was made to account for the small (a few percent) correction factors due to geometry of the vial or attenuation of gamma rays in the vial. Again, the accuracy of measurement is sufficient for diagnostic nuclear medicine procedures.

A more accurate calibration procedure could be devised by using another hospital's dose calibrator (which is accurate and has the ability to count the isotope in question) to measure the activity, and then simply set the potentiometer dial to give the same result as obtained at the other hospital. A chart could then be established for potentiometer dial setting for any isotope desired.

**References**


3. Private communication, Diagnostic Isotopes, Inc, Upper Saddle River, NJ

4. 3M Company, product literature for $^{169}\text{Yb}$ DTPA, 3M Center, St. Paul, MN