Limitations of $^{82}$Rb Weight-adjusted Dosing Accuracy at Low Doses

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INTRODUCTION

Weight-adjusted dosing of radiopharmaceuticals is recommended by AINS guidelines to maintain high image quality and to minimize radiation exposure to the patient.

The manufacturer of the only FDA approved $^{82}$Rb generator (CardioGen-82, Bracco Diagnostics) recommends recalibration for each change in dose [1] which is difficult in clinical settings.

OBJECTIVE

To evaluate the accuracy of dose calibration of the CardioGen-82 generator for one commonly used weight-adjusted dosing protocol.

METHODS

$^{82}$Rb Generator

Two consecutive $^{82}$Rb generators were evaluated (Fig. 1, CardioGen-82, Bracco Diagnostics).

Each generator was calibrated daily at a dose of 30 mCi.

Data acquisition

$^{82}$Rb doses between 10-60 mCi were eluted and measured in triplicate using an external dose calibrator (Capintec CRC-15R).

Each measured dose was decay-corrected to the time of the end of infusion and compared to the dose reported by the generator as a function of requested dose.

RESULTS

Figure 2: Typical profile of $82$Rb activity as it moves from the Patient Port into the system tubing. Each red line represents the summation of activity passing the Detector per second; red shaded region indicates tubing between Positron Detector and Divergence (Waste) Valve. Blue curve is the calculated space activity remaining at the time period indicated. Typical profile of $82$Rb activity as it moves from the Patient Port into the system tubing. Each red line represents the summation of activity passing the Detector per second; red shaded region indicates tubing between Positron Detector and Divergence (Waste) Valve. Blue curve is the calculated space activity remaining at the time period indicated.

Figure 3: Stacked area plots. Upper regions represent the Residual Dead Space Activity, lower regions represent the Actual Measured Dose. Colored bars indicate the requested dose. Red shaded region represents the Residual Dead Space Activity, lower regions represent the Actual Measured Dose. Colored bars indicate the requested dose.

Figure 4: Actual Measured Dose versus Generator-Reported values. The discrepancy is evident between Actual Measured Dose and Generator-Reported values. In both cases, the Actual Measured Dose was over-estimated but linearly related to the Generator-Reported values.

Figure 5: Analysis of $82$Rb activity profiles. Activity profiles for different Requested Doses for two generators at different times during the generator life-cycles. The shaded region under each curve represents the Residual Dead Space Activity; measured at the end of infusion. The activity curve for each Requested Dose is higher than the expected activity curve, indicating that residual Dead Space Activity is additive and increases with Requested Dose.

Figure 6: Stacked area plots. Upper regions represent the Residual Dead Space Activity, lower regions represent the Actual Measured Dose. Colored bars indicate the requested dose. Red shaded region represents the Residual Dead Space Activity, lower regions represent the Actual Measured Dose. Colored bars indicate the requested dose.

SUMMARY

Using a single calibration point (30 mCi), the decay-corrected Actual Measured Dose was over-estimated but linearly related to both Uncorrected and Corrected Reported Doses (8-25 mCi) to 10% at 30 mCi (Fig. 4).

Activity concentrations at the end of infusion were as much as six times higher for low doses (5 mCi) compared to high doses (30 mCi), leading to higher Residual Dead Space Activity for low doses (Figs. 3, 5).

The data suggest the primary source of discrepancy was the residual activity left in infusion system tubing dead space which was not flushed at the end of infusion (Fig. 6).

CONCLUSIONS

With the CardioGen-82 generator, significant over-estimation of injected doses occurred for requested doses smaller than the calibration dose.

Accurate weight-adjusted $^{82}$Rb dosing is possible if the weight-adjusted algorithm is modified to account for residual dead space activity.

Future iterations of generator design should include a flush of the dead space volume to simplify patient-specific dosing.

REFERENCES


DISCLOSURES