A software for automated calculations of technetium-99m generator

J.L. Gómez Perales[1], A. García Mendoza[2], M.E. Alcántara Vargas[1].
[1]Nuclear Medicine Service , "Puerta del Mar" University Hospital, Cádiz, SPAIN.
[2]Nuclear Medicine Service, "Torrecárdenas" Hospital, Almería, SPAIN

Objective

In the day-to-day practice of a radiopharmacy it is important to know at any time the available activity in a ^{99}Mo/^{99m}Tc generator. Due to the complexity of the calculations related to ^{99m}Tc generator, there are nomograms and tables, included in the datasheets of the generators, to facilitate these calculations. These methods of computation are not difficult, but they can be simplified further for routine application. The aim of this project is to develop a software for automatic calculation of ^{99}Mo and ^{99m}Tc activities, elution efficiency, specific activity and other parameters in a ^{99}Mo/^{99m}Tc generator.

Materials and methods

For developing a software incorporating this calculations we have written the solutions of the Bateman equations and other equations in Visual Basic 6.0. The activity of ^{99}Mo in the generator at any time is calculated by the standard radioactive decay formula: $A_{99Mo} = A_{99Mo}(0) \exp(-\lambda_{99Mo} t)$

The theoretic activity of ^{99m}Tc in the eluate at any time is calculated using the equation:

$$A_{99mTc} = A_{99Mo}\ 0.86\ \lambda_{99mTc}\ (e^{-\lambda_{99Mo}t} - e^{-\lambda_{99mTc}t}) / [(\lambda_{99mTc} - \lambda_{99Mo})\ e^{-\lambda_{99Mo}t}]$$

where λ_{99Mo} and λ_{99mTc} represent the decay constants for ^{99}Mo and ^{99m}Tc, respectively, and t is the time between two consecutive elutions. The specific activity of the eluate is calculated using the equations:

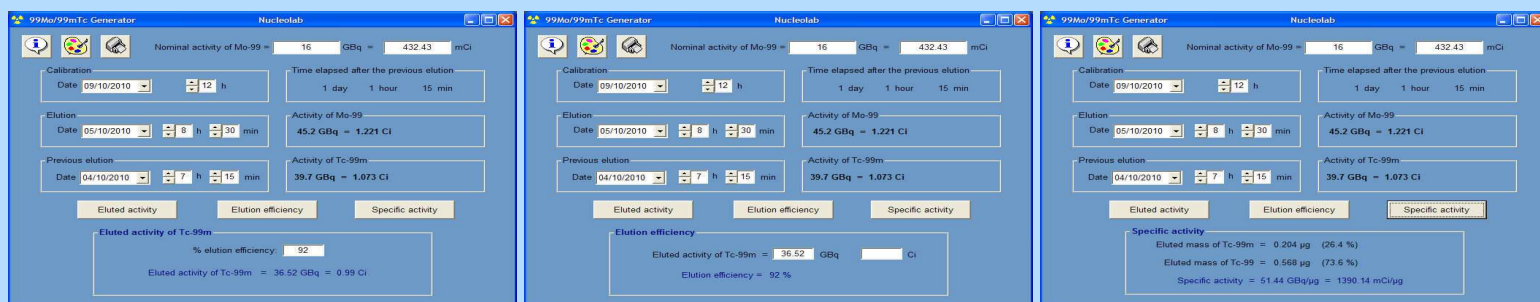$$\text{Specific activity} = A_0 / m_{Tc}$$

$$m_{Tc} = 1.9 \cdot 10^{-4}\ A_0 / h(t) \qquad h(t) = \lambda_{99Mo}\ (e^{-\lambda_{99Mo}t} - e^{-\lambda_{99mTc}t}) / [1.162\ (\lambda_{99mTc} - \lambda_{99Mo})\ e^{-\lambda_{99Mo}t}]$$

where m_{Tc} is the mass of both ^{99m}Tc and ^{99}Tc (in μg), A_0 is the activity of ^{99m}Tc (in mCi).

Results

We have developed a Generator Calculator for automatic calculation of 99Mo and 99mTc activities in the Generator at any time, the activity eluted according to the elution efficiency or vice versa, the elution efficiency, the specific activity and the masses of 99mTc and 99Tc in the eluate. The user has to input the following data: calibrated activity, date and time of calibration, date and time of elution and date and time of the previous elution. This Generator Calculator is included in Nucleolab, wich is a comprehensive software application available at: www.radiofarmacia.org/nucleolab-english

Conclusion

Generator Calculator is a software, with a friendly and easy-to-use interface, that makes the calculation complexity of ^{99}Mo/^{99m}Tc generator activities completely hidden for the user, saving you the time that you previously spent on these laborious calculations and reducing the risk of error.