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RESEARCH ARTICLE

EVALUATION OF THE ABSORBED DOSE IN THE KIDNEYS DUE TO Tc99m (DTPA) / Tc99m (MAG3) AND Tc99m (DMSA)

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ABSTRACT

The absorbed doses in the kidneys of adult patients have been evaluated using the biokinetics of radiopharmaceuticals containing Tc^{99m} (DTPA) / Tc^{99m} (MAG3) or Tc^{99m} (DMSA). The absorbed dose to the kidneys, was calculated using the formalism MIRD, and its representation Cristy-Eckerman. The absorbed dose in the kidneys, due to Tc^{99m} (DTPA)/Tc^{99m} (MAG3), are given by 0, 00466mGy.MBq⁻¹ / 0.00339 mGy.MBq⁻¹. Approximately 21.2% / 8.8% of the absorbed dose is due to the organs that are part of the biokinetics of Tc^{99m} (DTPA) / Tc^{99m} (MAG3): bladder (content) and remaining tissue. The absorbed dose to the kidneys due to Tc^{99m} (DMSA) is 0.17881 mGy. MBq⁻¹. Here, 1.7% of the absorbed dose is due to the organs that are part of the biokinetics of Tc^{99m} (DMSA): bladder, spleen, liver and the remaining tissue.

Key words:

MIRD dosimetry; DTPA / MAG3 and DMSA

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INTRODUCTION

The estimate of the dose absorbed by the kidneys, for renal function studies of adult patients, can be realized by analyzing the biokinetics of radiopharmaceuticals used, containing Tc^{99m} (DTPA) / Tc^{99m} (MAG3) or Tc^{99m} (DMSA).

MATERIALS AND METHODS

To estimate the dose absorbed by the kidneys, due to contributions dosimetric the organs that are part of the biokinetics, were used formalism and representation MIRD Cristy-Eckerman to those tissues. Medical Internal Radiation Dosimetry considered equations (Argentina Association of Nuclear Medicine and Biology, 2013):

$$\frac{D_{\text{fotones}}(\text{riñones})}{A_0} = \sum_{i=1} \left[\sum_k \Delta_k \Phi_k(\text{riñones} \leftarrow i) \right] \tau_i \quad \text{rad} / \mu\text{Ci}$$

$$\frac{D_{\text{particula}}(\text{riñones} \leftarrow \text{riñones})}{A_0} = \left[\bar{E}_{\text{particula}} \frac{\tau_{\text{riñones}}}{m_{\text{riñones}}} + \bar{E}_{\text{particula}} \frac{\tau_{TB}}{m_{TB}} \right] \times 2,13 \quad \text{rad} / \mu\text{Ci}$$

τ_{TB} = total residence of the body

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m_{TB} = total body mass

The absorbed fractions, ϕ_k (kidneys $\leftarrow i$) g⁻¹, of the “i” analyzed organs (i: kidneys, bladder and remaining tissue, for DTPA / MAG3; kidneys, liver, spleen, bladder, and remaining tissue, for DMSA), for photon energies “k” of Tc^{99m} were obtained from ORNL/TM-8381/V7 (Cristy y Eckerman, 1987a). Residence times of radiopharmaceuticals mentioned, in each organ biokinetics, given in tables 1 and 2, were obtained from the (HPS, 2013a).

Table 1 Residence time (hours) for organs of the biokinetics of Tc^{99m} (DTPA)/ Tc^{99m} (MAG3) (HPS, 2013a)

Órgans RFM	Kidneys	Bladder content.	Remaining tissue
Tc ^{99m} (DTPA)	0.073	1,510	1,970
Tc ^{99m} (MAG3)	0.065	2.61	0.232

Table 2 Residence time (hours) for organs of the biokinetics of Tc^{99m} (DMSA) [HPS, 2013a]

Órgans RFM	Kidneys (cortex)	Blader content.	Ramainigtissu Spleen	Liver	
Tc ^{99m} (DMSA)	3,71	0,40	6,770	0,042	0,418

$$\Delta_k = 2,13 n_k E_k \left(\frac{rad - gm}{-Ci - hr} \right), \text{ represents average}$$

energy of the “k” photons emitted in the decay of Tc^{99m}, given in Table 3, were obtained from web page (HPS, 2013b).

Table 3Data nuclear emitted photons (MeV) of Tc^{99m}most significant (HPS, 2013b)

RFM	Photons	E_k (Me V)	n_k /des	$\Delta_k = 2,13 n_k E_k \left(\frac{rad - gm}{-Ci - hr} \right)$
Tc ^{99m}	Gammaradiation	0,1405	0,8906	0,2665
		0,1426	0,0002	0,0001
	Chracteristicradiation	0,0183	0,021	0,0008
		0,0184	0,040	0,0016
		0,0206	0,012	0,0005

$\bar{E}_{particle}$ (MeV/des), represents the average energy of particles emitted by the Tc^{99m}, this is, represents the electron appearing in the decay processes for capturing and Auger electrons, are given in Table 4 and were obtained from web page (HPS, 2013b).

Table 4Nuclear data for emitted particles (MeV) of Tc^{99m} most significant (HPS, 2013b)

RFM	Particles	E_k (MeV)	n_k /des	$n_k E_k$ (MeV/des)	$\bar{E}_{particle} = \sum n_k E_k$ (MeV/des)
Tc ^{99m}	Conversion electrons	0,1195	0,088	0,01052	0,01439
		0,1216	0,0055	0,00067	
		0,1375	0,0107	0,0015	
		0,1396	0,0017	0,00024	
		0,140	0,0019	0,00026	
	Auger electrons	0,0016	0,746	0,0012	
		0,0022	0,102	0,00022	
		0,0155	0,0207	0,00032	

Mass values the kidneys, and remaining tissue of the biokinetics, were obtained from ORNL/TM-8381 /V1 (Cristy y Eckerman, 1987b).

Table 5 Mass values (g) to kidneys and remaining tissues of adults, in the representation representation Cristy - Eckerman (Cristy y Eckerman, 1987b)

Mass (grams)	ADULTO
Kidneys	299
Remaining tissue (TB)	73700

Table 6Absorbed dose in adult kidneys due to Tc^{99m} (DPTA) / Tc^{99m} (DMSA) and Tc^{99m} (MAG3), in the representation and Eckerman Cristy-MIRD formalism (mGy / MBq)

RFM	Emissions	$D(r_{i\bar{n}} r_{i\bar{n}})/A_0$	$D(r_{i\bar{n}} i)/A_0^*$	Sub-total	Total (mGy/MBq)
Tc ^{99m} (DTPA)	photons	0.00123 (26.4%)	0.00099	0.00234	0.00466
	x-Radiation	0.00012 (2.6%)	(21.2%)	(50.2%)	
	Convers	0.00224 (48.1%)	-	0.00232	
	Augerelect.	0.00008 (1.7%)	-	(49.8%)	
Tc ^{99m} (DMSA)	photons	0.06248 (34.9%)	0.00307	0.07184	0.17881
	x-Radiation	0.00629 (3.5%)	(1.7%)	(40.1%)	
	Conversion	0.10309 (57.6%)	-	0.10697	
	Auger elect.	0.00388 (2.2%)	-	(59.8%)	
Tc ^{99m} (MAG3)	photons	0.00109 (32.2%)	0.00030	0.00150	0.00339
	x-radiation	0.00011 (3.2%)	(8.8%)	(44.2%)	
	Conversion	0.00182 (53.7%)	-	0.00189	
	Auger elect.	0.00007 (2.1%)	-	(55.8%)	

(*) i= all source except the kidneys.

Using the MIRD scheme and representation of Cristy-Eckerman for adult kidneys of patients, the study is to demonstrate whether the dosimetric contributions of organs that are part of the biokinetics (excluding kidneys) of Tc^{99m} (DTPA) / Tc^{99m} (DMSA), and Tc^{99m} (MAG3), are significant in the estimated of the absorbed dose for renal function studies.

RESULTS

DISCUSSION

Absorbed dose to the kidneys of an adult, due to emissions of Tc^{99m} (DMSA): 0.17781 mGy / MBq: 98.2% of the dose correspond to self-dose (57.6% to electron conversion, 2.2% due to Auger electrons, 34, 9 % to gamma photons, and 3.5% to radiation characteristics); and 1.7%, remaining, the organs of the bladder, spleen, liver and remaining tissue, which are included in the biokinetics of Tc^{99m} (DMSA). The dosimetric contributions are primarily due to photons emitted by the bladder and the rest organ (remaining tissue).

Absorbed dose to the kidneys of an adult, due to emissions of Tc^{99m} (DTPA): 0.00466mGy / MBq: 78.8% of the dose correspond to **self-dose** (48.1 % to electron conversión, 1.7 % due to Auger electrons, 26.4 % to gamma photons, and 2.6% to radiation characteristics); and **21.2 %**, remaining, the organs of the bladder and remaining tissue, which are included in the biokinetics of Tc^{99m} (DTPA). The dosimetric contributions are primarily due to photons emitted by the bladder and the rest organ (remaining tissue).

Absorbed dose to the kidneys of an adult, due to emissions of Tc^{99m} (MAG3): 0,00339mGy / MBq: el 91.2% of the dose correspond to **self-dose** (53.7 % to electron conversión, 2.1 % due to Auger electrons, 32.2 % to gamma photons, and 3.2% to radiation characteristics); and **8.8 %**, remaining, the organs of the bladder and remaining tissue, which are included in the biokinetics of Tc^{99m} (MAG3). The dosimetric contributions are primarily due to photons emitted by the bladder and the rest organ (remaining tissue). In all cases, the dosimetric contributions of the organs, which are part of the biokinetics of radiopharmaceuticals used (excluding kidney), are significant to be ignored.

are consistent with those published in ICRP-53 (Drugs a, 2015, Drugs b, 2015, Drugs c, 2015). Depending on the type of radiopharmaceutical and its biokinetics, shall the significance of their contributions in the estimated dose absorbed by the kidneys (Vásquez *et al*, 2015)

CONCLUSIONS

Using the MIRD methodology, and Cristy-Eckerman representation kidneys of adults patients, demonstrated that, during studies of renal function, the dosimetric contributions of organs, that are part of the biokinetics (excluding kidney) of Tc^{99m} (DPTA)/ Tc^{99m} (DMSA), y del Tc^{99m} (MAG3), are very significant in the estimated absorbed dose to the patient.

References

- Argentina Association of Nuclear Medicine and Biology. Dosis de radiación recibida por los pacientes tras la administración de radiofármacos. A bymn.O rg.ar/archivos/dosisradiacion.pdf. (2014).
- Cristy M. y Eckerman K.. Specific absorbed fractions of energy at various ages from internal photons Sources, Oak Ridge, TN: ORNL/TM-8381 /V7, (1987a)
- Cristy M. y Eckerman K. "Specific absorbed fractions of energy at various ages from internal photons Sources. Methods", Oak Ridge, TN: ORNL/TM-8381/V1 (1987b)

- Health Physics Society. Kinetic Models Used as the Basic for the Dose Estimates, www.doseinfo-radar.com/NMdos es.xls (2013a)
- Health Physics Society. Kinetic Models Used as the Basic for the Dose Estimates, <http://hps.org/publicinformation/radardecaydata.cfm>, (2013b).
- Quimby, E., Feitelberg, S., Gross, W.. Radiactive Nuclides in Medicine and Biology. Third edition. Lea & F. Philadelphia: 2332-236, (1970)
- Drugs a (online). Technetium Tc 99m suc cimer. <http://www.drugs.com/mmx/technetium-tc-99m-succimer.html> [Recuperado, junio, 2015]
- Drugs b (online). Technetium Tc 99m pentetate. <http://www.drugs.com/mmx/technetium-tc-99m-pentetate.html> [Recuperado, junio, 2015]
- Drugs c (online). Technetium Tc 99m mer tiadit e <http://www.drugs.com/mmx/technetium-tc-99m-mertiatide.html> [Recuperado, junio, 2015]
- Vásquez, M, Díaz, E., Castillo, C. *et.al.*, (2015) "Dosimetric evaluation due to radiation in thyroid issued by the I-123 / I-131 (Hippuran) and In-111 (DPTA)", Braz. J. Rad. Sci. 3(2)
- Vásquez, AM.; Castillo, DC.; Vasquez, DJ.; Rocha MD.; Garcia, RW. (2015) Dosimetric evaluation due to radiation in thyroid issued by the Tc-99m and I-131 ; Int. Res. J. Eng. Sci. Technol. Innov. 4(1) 1-4.

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