Assessment, using Monte Carlo and Biokinetic Models, of the Absorbed Dose in the Thyroid, as a Critical Organ, in Scintigraphies with $^{123}$I and $^{99m}$Tc

1. Introduction
In scintigraphies with $^{99m}$TcO$_4$ or I$^*$

2. Objectives
Optimize, in the patient dosimetry and radiological protection point of view, of the current blocking thyroid protocols

Calculate the absorbed dose in the thyroid resulting of scintigraphic studies with considered isotopes

3. Methods

3.1 Exam selection → $^{123}$I-DaTscan$^\circledR$ | $^{123}$I-mIBG | Scintigraphy for Meckel’s diverticulum search | MUGA

3.2 Biokinetic Models application
ICRP + ORNL → Total number of disintegrations in the thyroid → Ås

3.3 Voxel Phantoms implementation
Monte Carlo methods (PENELOPE v.2008 + penEasy).

To estimate the absorbed dose in the thyroid

4. Results

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Thyroid Dose (mGy)</th>
<th>Adults ICRP (A)</th>
<th>Golem (B)</th>
<th>Laura (C)</th>
<th>Difference Golem/ICRP (B/A)-1</th>
<th>Difference Laura/ICRP (C/A)-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUGA</td>
<td>4.22</td>
<td>0.23</td>
<td>0.16</td>
<td>-94.55</td>
<td>-96.21</td>
<td></td>
</tr>
<tr>
<td>MD</td>
<td>0.48</td>
<td>0.06</td>
<td>0.04</td>
<td>-87.80</td>
<td>-91.67</td>
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<tr>
<td>mMBG</td>
<td>0.84</td>
<td>0.12</td>
<td>0.08</td>
<td>-85.71</td>
<td>-90.48</td>
<td></td>
</tr>
<tr>
<td>DaTScan</td>
<td>9.25</td>
<td>0.08</td>
<td>0.06</td>
<td>-59.14</td>
<td>-93.35</td>
<td></td>
</tr>
</tbody>
</table>

5. Conclusions

- $^{99m}$TcO$_4$ → results about 90% lower than those given by ICRP;
  Calculated doses → more than 50 times below the ARSAC threshold → the “no blocking” protocol is adequate

- $^{123}$I → results much lower than those given by ICRP – 85 - 90% for mIBG and about 100% for DaTscan$^\circledR$.

The optimization of thyroid blocking protocols for procedures with $^{123}$I is possible!