Individual Monitoring of Internal Exposures for Nuclear Medicine Workers in Argentina

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INTRODUCTION

Situation of occupational exposure in nuclear medicine

External individual monitoring: is required
Internal individual monitoring: is NOT required

BUT

IAEA Safety Standards Series - Safety Guide No RS-G-1.2
“Assessment of occupational exposure due to intakes of radionuclides”

“The internal monitoring should be carried out whenever the potential internal exposure leads to a value of annual committed effective dose equal or higher than 1 mSv”
OBJECTIVE

To propose an individual monitoring procedure feasible to implement routinely with the instrumentation available in the FUESMEN nuclear medicine center for the control of $^{131}$I internal exposures in normal and accidental scenarios.
• Radionuclide of interest: $^{131}$I

• Detector System available: Gamma cameras

Advantage:
Gamma cameras have enough sensitivity to detect $^{131}$I thyroid burden corresponding to effective doses below 1 mSv
[IAEA-ARCAL Project RLA/9/049]

Disadvantage:
Gamma cameras are used to scan patients for medical purposes with a very high demand
• Radionuclide of interest: $^{131}\text{I}$

• Detector System available: surface monitors

Advantage:
Surface monitors are available
Exclusively for radiation protection purpose

Calibration procedure $\rightarrow$ (MDA) Minimum Detectable Activity

MDA $\rightarrow$ Minimum$^{131}\text{I}$ intakes $\rightarrow$ Minimum $E(50)$
A calibration procedure, feasible to implement, is performed and the Minimum Detectable Activity (MDA) is calculated.

The neck phantom: polyethylene cylinder (11.4 cm diameter and 11.3 cm high), developed by Institute of Radiation Protection and Dosimetry of Brazil (IRD) in the frame of Project IAEA/ARCAL RLA 9/049.

<table>
<thead>
<tr>
<th>Detector</th>
<th>Characteristics</th>
<th>MDA (kBq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geiger-Mueller Halogen-quenched</td>
<td>Ø = 45mm, 1.5-2.0 mg/cm² Mica window</td>
<td>9.1</td>
</tr>
<tr>
<td>Geiger-Mueller</td>
<td>Ø = 45mm, 2 mg/cm² Mica window</td>
<td>9.2</td>
</tr>
<tr>
<td>Plastic scintillator</td>
<td>3”×3” plastic scintillator</td>
<td>2.1</td>
</tr>
</tbody>
</table>
DETECTORS RESPONSE

\[ E(50) = e_{inh}(50) \times \frac{MDA}{m(t)} \]

- **Detector**
  - **MDA (kBq)**
  - **E(50)_{min} (mSv)**

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\( m(t) \): theoretical retention fraction in thyroid

**Conservative hypothesis:**

- \(^{131}\text{I} \) vapour
  \[ e(50) = 2 \times 10^{-8} \text{ Sv/Bq} \]
  (ICRP68)

- Time after exposure = 1 day
  \[ m(t) = 0.23 \]
  (ICRP 78)
MONITORING PROCEDURE

1. Screening monitoring
   - M ≥ MDA
     - NO: Register Measurement (Bq)
     - YES: Confirmatory monitoring

2. Confirmatory monitoring
   - M ≥ MDA
     - NO: Register Measurement Datum (Bq)
     - YES: IDEAS guidelines criteria

3. Internal dose assessment
   - Register: $^{131}$I E(50) (mSv)

Guías IDEAS. FZKA 7243 2006
CONCLUSIONS

The surface detectors available in FUESMEN Nuclear Medicine Center for radiation protection purpose have an adequate response for a first screening to detect potential workers intakes.

In case that a positive result is obtained, the use of a gamma camera and the application of IDEAS Guidelines criteria allows to complete the process of internal dose assessment.

The proposed procedure is easy to implement and it could contribute to control the workers $^{131}$I internal exposures in nuclear medicine.
Ana María Rojo
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