New technology in 18F-FDG handling by technologists: impact of fully automated dispensing on staff radiation protection

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Goal

Quantification of the radiation protection benefit to technologists provided by a fully automated fractionating device in comparison with manual syringe filling, and their dedicated injection devices.
Material and Methods

BEFORE: Lermerpax high energy cell (2004)

AFTER: Trasis Unidose automated cell (2010)

Before Lermerpax high energy cell (2004)
Material and Methods

We compared:
- whole-body doses and extremity doses
- over 2 two-week periods
- before and after the installation of the system
Material and Methods

We used:

- An ion storage dosimeter (operational dosimetry) to measure whole-body radiation doses
- 4 thermoluminescent ring dosimeters (passive dosimetry) to measure extremity radiation doses (indexes + thumbs)

Operational dosimeter

- Siemens EPD Mk2
- X, γ, β-
- Energy range: X, γ: 15 keV to 10 MeV, β: 100 keV to 2 MeV
- Dose range: 0 to 16 Sv
- Dose rate range: 0 to 4 Sv/h

Ring dosimeters (Thermo Luminescent Device)

- LCIE LANDAUER
- FLi pellets
- Energy range: X, γ: 15 keV to 8 MeV, β: from 150 keV
- Dose range: 0.2 mSv to 10 Sv
Material and Methods

These dosimeters were worn exclusively while preparing and administering $^{18}$F-FDG doses.

<table>
<thead>
<tr>
<th>Radiametre RAM DA 3-2000</th>
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<tbody>
<tr>
<td><strong>Dose rate range</strong></td>
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<tr>
<td><strong>Range display</strong></td>
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</tbody>
</table>
Results

BEFORE

- Contact syringe shield: 2.04 mSv/h (220 MBq)
- Behind semi-automated injector: 9.42 µSv/h (220 MBq)
- Contact glove box: 12.2 µSv/h (1.5 GBq inside)

AFTER

- Contact syringe shield: 66.28 µSv/h (220 MBq)
- Behind shield: 2.42 µSv/h (220 MBq)
- Contact of automated cell: 1.04 µSv/h (1.5 GBq)
Results

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>115</td>
<td>88</td>
</tr>
<tr>
<td>Total administered activity (MBq)</td>
<td>25030</td>
<td>19337</td>
</tr>
<tr>
<td>Total whole-body dose (µSv)</td>
<td>331</td>
<td>78</td>
</tr>
<tr>
<td>Mean whole-body dose per administered activity (µSv/MBq)</td>
<td>0.013</td>
<td>0.004</td>
</tr>
<tr>
<td>Mean whole-body dose per patient (µSv/patient)</td>
<td>2.87</td>
<td>0.89</td>
</tr>
<tr>
<td>Highest ring dose (thumb &amp; index of dominant hand) (mSv)</td>
<td>8.2</td>
<td>0.40</td>
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<tr>
<td>Mean ring dose per administered activity (µSv/MBq)</td>
<td>0.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Mean ring dose per patient (µSv/patient)</td>
<td>71</td>
<td>4.5</td>
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</tbody>
</table>

Conclusions

**63% reduction** of whole-body radiation doses to technologists

**95% reduction** of extremity radiation doses to technologists
Conclusions

Exposure of technologist per 370 MBq dose prepared and injected:

- whole-body: **1.48 µSv**
- Extremities: **7.4 µSv**

NB: manufacturer announces ~1 and <20 µSv respectively