I-131 Patient release criteria based on dose rate measurements at the Bank of Cyprus Oncology Centre (BOCOC), Cyprus

K Michael 1 and G Antoniou2

1Bank of Cyprus Oncology Centre, Nicosia, Cyprus
2University of Cyprus, Nicosia, Cyprus

Introduction

At the BOCOC patients who have radioiodine (I-131) ablation therapy are released from the hospital when the dose rate at 1 m is less than 40μSv/h according to the European Commission’s Directive 97 (RP 97). All patients are advised to avoid contact with children for at least two weeks after administration and avoid prolonged and close contact with adults for the same period of time. Following their release, all patients return to the hospital for further measurements and all restrictions are retrieved when dose rate is less than 3μSv/h. This study was set out to investigate the time depended dose rate after I-131 administration and estimate the effective half-life (τeff) for each patient. Finally, individual restriction periods were derived to limit contact to a member of the public or household to less than 300μSv (MDGN).

Materials and methods

External whole body dose rates at 1m from 106 patients were measured with a survey meter (Victoreen, 451P) immediately after administration and at intervals for up to 7 days after administration. At discharge dose rate measurements at 0.5, 1, 1.5 and 2m were also taken. 58 patients were prescribed 3700MBq and 48 patients were prescribed 5500MBq. Non linear regression (Microsoft Excel Solver) was used to plot the measured dose rate against time (clearance rate) and the effective half-life (τeff) of the decay was found for each patient. The resulted relationship was used to calculate cumulative exposure doses to persons who may come in contact with the patient. Assumptions for contact patterns of the patient with different groups of people (Figure 1) were made and restriction periods for each group of people were then obtained so that the dose containment of 300μSv/year is not exceeded. Restriction periods were calculated using iterative methods as described by Cormack and Shearer.

Results

Excel solver (GRG Non linear) was used to establish the clearance rate (dose rate vs time) for each patient. For 78% of the patients a bi-exponential decay fit the data better than a single exponential with a fast clearance phase to be followed by a slower clearance phase. Therefore, for this study a bi-exponential relationship was used for all patients (Equation 1).

$$D(t) = A_1e^{-\lambda_1t} + A_2e^{-\lambda_2t} + \text{Teff}$$

Where: D is the dose rate in μSv/h, A1 and A2 are constants and Teff is the effective half-lives for phase 1 and phase 2 respectively.

On average τeff values for all patients were 9.7 and 23.8 for the first and second phase respectively. For the patients that were prescribed 5500MBq, τeff was slightly lower (9.2h phase 1 and 19.9h phase 2) than the patients that were prescribed 3700MBq (10.1h phase 1 and 27.1h phase 2). Figure 2 shows distribution of τeff for the two phases for all patients.

Discussion

Patients at the BOCOC are kept in the hospital for at least 2 days and until their dose rate measurement at 1 meter is less than 40μSv/h. The doses received by members of the public and family of the patient following the release of the patient from the hospital will depend on the dose rate emitted by the patient and their clearance rate but also will be influenced by the proximity and contact with the patient. We have shown that the dose rate at the time of release and the clearance rate of each patient vary significantly. In addition, most patients are released from hospital with dose rates much lower than 40μSv/h. For these reasons advise given should not be the same for all patients, but should be tailored to personal circumstances and behavioural patterns of each patient.

We have developed a method that uses Microsoft Excel to estimate the clearance rate from dose rate measurements and calculate the dose received by the members of the public and family members of I-131 patients. Furthermore, the spreadsheet can be used to calculate restriction times for any behavioural pattern and any dose constraint. This last feature was found useful when making calculations for carers of young patients or patients with young children. Finally patients do not need to return to the department to be measured which is inconvenient for the patient and the department.

Literature cited


Contact information

•Medical Physics Department, Bank of Cyprus Oncology Centre, Nicosia, Cyprus
•Email: kostas.michael@bococ.org.cy

Table 3: Close contact delay times for patients Groups C to F

<table>
<thead>
<tr>
<th>Delay time (h)</th>
<th>Group C</th>
<th>Group D</th>
<th>Group E</th>
<th>Group F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>50.5</td>
<td>157.9</td>
<td>142.9</td>
<td>120.5</td>
</tr>
<tr>
<td>Max</td>
<td>219.1</td>
<td>501.2</td>
<td>457.1</td>
<td>404.4</td>
</tr>
<tr>
<td>Min</td>
<td>19.4</td>
<td>61.4</td>
<td>59.7</td>
<td>51.4</td>
</tr>
</tbody>
</table>