Clinical note

Giving radioiodine? Think about airport security alarms

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\textbf{A R T I C L E  I N F O}

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\textbf{A B S T R A C T}

An increased sensitivity of airport detectors, a growing number of isotopic tests, and globalization of the society have raised a number of false positive radioactive alarms at airports and public places. This paper presents two new cases of patients who triggered airport security alarms after receiving 740 MBq of $^{131}$I for non-toxic goitre and attempts to compare surprisingly limited literature concerning this problem. A 57-year-old man triggered a security alarm at three different airports on the 17th, 28th, and 31st day after radioiodine exposure. Interestingly enough, in the meantime, on the 18th and 22nd day, no radiation was detected in him at the airport where he was twice detained as a source of radiation later on. The second case presents a 45-year-old woman who activated security alarm detectors while crossing a border on her coach trip 28 days after radioiodine administration.

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\textbf{R E S U M E N}

La sensibilidad aumentada de los detectores en los aeropuertos, el aumento del número de pruebas isotópicas y la globalización de la sociedad han dado lugar a varias falsos positivos en las alarmas de radiactivos de los aeropuertos y lugares públicos. Este trabajo presenta dos nuevos casos de pacientes que alertaron las alarmas de seguridad en el aeropuerto después de haber recibido 740 MBq de $^{131}$I en bocio no-tóxico. Los intentos de comparar la literatura son sorprendentemente limitados en relación a este problema. Un hombre de 57 años desencadenó una alarma en tres aeropuertos diferentes durante los días 17, 28 y 31 después de haber recibido exposición a yodo radioactivo. Curiosamente, mientras tanto, en los días 18 y 22, no se detectó la radiación en el aeropuerto, donde fue detenido dos veces más adelante como fuente de radiación. El segundo caso presenta una mujer de 45 años que activó los detectores de la alarma de seguridad cuando cruzó una frontera en un viaje en autobús después de haber recibido yodo radioactivo.

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\textbf{I n t r o d u c t i o n}

An increased sensitivity of airport detectors, a growing number of isotopic tests, and globalization of the society have raised a number of false positive radioactive alarms at airports and public places. Surprisingly, the available literature concerning this problem is very limited. Here, we report the data related to the activation of radiation detectors, along with two new case reports.

In the medical database we found as few as only 7 papers being related to the problem of radiation in public places after radioiodine.\textsuperscript{1–7}

The case of a 76-year-old patient treated for the toxic multinodular goitre with 4 mCi who was detained 25 days after the treatment and thoroughly searched after having triggered the alarm at Vienna airport\textsuperscript{1} motivated the researchers to draw up a certificate confirming the administration of radioactive substances.

However, caring the certificate does not guarantee an unproblematic trip, as it is shown in the next report, which describes a businessman who received 300 MBq $^{131}$I to treat hyperthyroidism in Graves’ disease.\textsuperscript{2} Seven days after $^{131}$I administration, at the airport in Los Angeles, a portable detector indicated his radiation. Similarly, he triggered the alarms at the check-in twice in the following week while crossing the US border. Although he was carrying a medical certificate confirming radioiodine therapy, he was never able to avoid embarrassing interrogation and a detailed strip-search.

The details of the other five already published cases can be found in Table 1.

\textbf{Case report}

Our patient, a 57-year-old male with non-toxic goitre, received 740 MBq of $^{131}$I to reduce the size of the gland.\textsuperscript{3} The goitre volume was 242 ml, whereas the iodine uptake 53%. Based on a certificate suggested by Sinzinger et al.,\textsuperscript{1} we drew up a similar one confirming treatment with radioiodine (Fig. 1). Seventeen days after administration of $^{131}$I, at Gdansk airport, Poland, the patient triggered the
security alarm. Fortunately, showing the certificate was enough for him to be allowed to continue his journey.

On the next day, i.e. on the 18th day after the treatment, the patient flew from Bremen, Germany, to Paris, France, and next from Paris to Bayonne, France. The alarm was not triggered at any of those three airports. Likewise, on his way back, Bayonne-Paris-Bremen, on the 22nd day after the treatment, the patient could freely pass the security gates. Surprisingly, on the 28th day, while flying from Germany to Italy, he triggered a security alarm at Bremen airport (previously visited on the 18th and 22nd day). Fortunately, his medical certificate was enough for the customs officials to let him board the plane. The alarm was triggered again while flying from Rome to Valencia, on the 31st day. For the third time his medical certificate was a sufficient proof of his radioactivity for the customs officials.

Table 1
Published cases of triggering airport security alarms reported up till now with the activity of radioactive therapeutic substances received by the patients and the number of days of radiation.

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Patient’s age (years)</th>
<th>Sex</th>
<th>Thyroid disease</th>
<th>Activity (MBq)</th>
<th>Alarm activation time after the patient received 131-I (days)</th>
<th>Activity calculated on the day of triggering the alarm (MBq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
<td>76</td>
<td>F</td>
<td>Toxic multinodular goitre</td>
<td>148</td>
<td>25</td>
<td>17.16</td>
</tr>
<tr>
<td>[2]</td>
<td>NA</td>
<td>M</td>
<td>Graves disease</td>
<td>296</td>
<td>7</td>
<td>161.90</td>
</tr>
<tr>
<td>[4]</td>
<td>46</td>
<td>F</td>
<td>Thyrotoxicosis without defining a disease</td>
<td>400</td>
<td>42</td>
<td>10.71</td>
</tr>
<tr>
<td>[6]</td>
<td>69</td>
<td>M</td>
<td>Not defining</td>
<td>185</td>
<td>15</td>
<td>50.78</td>
</tr>
<tr>
<td>[5]</td>
<td>57</td>
<td>F</td>
<td>Non-toxic multinodular goitre</td>
<td>1110</td>
<td>24</td>
<td>140.25</td>
</tr>
<tr>
<td>[6]</td>
<td>57</td>
<td>M</td>
<td>Graves disease</td>
<td>185</td>
<td>13</td>
<td>60.33</td>
</tr>
<tr>
<td>[7]</td>
<td>34</td>
<td>F</td>
<td>Non-toxic multinodular goitre</td>
<td>740</td>
<td>21</td>
<td>121.10</td>
</tr>
<tr>
<td>Our case</td>
<td>57</td>
<td>M</td>
<td>Non-toxic multinodular goitre</td>
<td>740</td>
<td>17</td>
<td>170.95</td>
</tr>
<tr>
<td>Our case</td>
<td>45</td>
<td>F</td>
<td>Non-toxic multinodular goitre</td>
<td>740</td>
<td>31</td>
<td>51.14</td>
</tr>
</tbody>
</table>

During further flights which took place on the 34th, 39th, 43rd, 45th and 48th day from the treatment, upon arriving at the airports in Italy, Spain, France and Israel no alarms were triggered.

Our second case is a 45-year-old patient after surgical excision of a non-toxic goitre in 1988 who was administered 740 MBq of $^{131}$I due to the goitre regrowth. The thyroid volume was evaluated as 60 ml with the iodine uptake of 23%. Three weeks after the administration of radiiodine, the patient was on the way back from her trip outside the eastern border when her coach activated the security alarm detectors. Suspecting a false positive alarm, the customs officials ordered the passage via the surveillance gates three more times with the same result. Finally, after a suggestion of one of the customs officials, our patient realized that she might have triggered the alarm. Fortunately, she was allowed to return home after an extensive explanation about the nature of the treatment she underwent (the day of detention was the 28th day after the treatment).

Discussion
Since the 11 September 2001 attacks on the World Trade Center, all security procedures have been strengthened. Recently introduced restrictions have resulted in an increased number of false positive alarms and unnecessary detainment, which has violated the passengers’ autonomy. Consequently, a question arose how to differentiate smuggling and trading of nuclear weaponry from treatment with radioactive substances.

Sinzinger et al. have constructed a certificate confirming treatment with radioactive substances. However, Palumbo et al. indicate that such a note does not guarantee an eventful border crossing. His patient was allowed to continue her journey only after the authenticity of her certificate had been confirmed via telephone with the Nuclear Medicine Centre, where she was being treated.

Hence, the first problem is the researchers’ awareness of false positive alarms, which forces them to issue a relevant certificate to the patient before a journey abroad.

Next problem is the lack of a uniform certificate, which incurs falsification and subsequently undermines their credibility. Placing an issuing body contact telephone number on it would enable verification of its authenticity, but it would still be hard to expect the issuing body to await phone calls 24 h a day.

Another essential matter is the necessity to provide every single $^{131}$I treated patient with a certificate. The example of one of our patients evidently showed that unscheduled situations might require having taken such a note as security alarms may be triggered all over the country.
What is also important is to specify the time following radioisotope treatment within which the radiation may be sensed by a security detector.

In Table 1, on the assumption that a half-life of radioiodine is 8.04 days, we calculated the amount that would have remained from the administered activity a certain time after the treatment.

Analyzing the data above, we could presume that the lowest activity of radioiodine activating detectors was 10.71 MBq.4 Evidently, the comparison is possible only when we assume, however erroneously, that the thyroid iodine uptake in all the above patients was the same and amounted to 100% and that at the moment of radioactivity detection the distance from the detector was equal in all individuals. Surprisingly enough, the longest radiation emission time, 5 weeks after \(^{131}\text{I}\) treatment, was detected in the patient with the lowest calculated activity at the moment of detention, and not in the patient who received over twice as high activity of 1110 MBq, and whose activity calculated on the 38th day after the treatment amounted to 41.27 MBq. This almost fourfold range is interesting. The simplest explanation lies in the difference in the detector’s sensitivity. Undoubtedly, other significant factors were: the detector’s position and distance from the individual, thyroid iodine uptake, which is known to be lower in a non-toxic goitre than in thyrotoxicosis, and finally specific metabolism of the thyroid tissue.

On the example of our patient, we could see that on the 17th and the 28th day the patient triggered alarms at two different airports. Surprisingly, in the time between those two incidents, on the 18th and 22nd day, no radiation was detected although the patient was at the same airport where on the 28th day he was found to be the source of radiation. This example shows how the sensitivity of security detectors may differ even within the same airport. When the patient triggered the detector for the last time on the 31st day, the calculated activity was lowered to 52 MBq. Although the calculated activity of \(^{131}\text{I}\) in subsequent time periods, i.e. on the 34th, 39th, 43rd, 45th, and 48th day (39.5, 25.7, 15.3, 18.2, and 11.8 MBq, respectively), still exceeded the minimum calculated activity, it was too low to trigger alarms.

What hinders a thorough scientific analysis and makes the further consideration of the radiation time impossible is both the scarce number of reported cases and the lack of available information related to the detectors’ parameters from airport security officials.

In this deadlock situation, the only way is to assume like others and as American researchers suggest that the emission time after \(^{131}\text{I}\) administration which still bears the risk of triggering security detectors is 95 days (Table 2).

### Conclusions

A partially successful solution to the problem of radiation of the patients treated with \(^{131}\text{I}\) is the certificate proposed by Sinzinger et al.; however, it would be advisable for all issuing bodies to have its unified version so as to avoid forgery. Another option could be a European database of patients treated with radioisotopes which would facilitate verification of an individual suspected of smuggling radioactive substances.

We believe it is only a matter of time that new requirements shall be enforced on the centers of the nuclear medicine by public security services.

### References