CASE REPORT

Radioiodine retention on percutaneous endoscopic gastrostomy tubes

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ABSTRACT. An 80-year-old male with recurrent thyroid cancer and a percutaneous endoscopic gastrostomy (PEG) tube *in situ* was referred for radioiodine therapy and was administered 5510 MBq I-131 sodium iodide intravenously. Sequential whole-body images taken over the subsequent 7 days for dosimetric evaluation revealed an area of persistent high uptake in the abdomen. Delayed imaging with single photon emission CT/CT at 15 days post administration revealed this uptake to be at the junction of the PEG tube with the anatomically normal stomach wall. We hypothesise that the PEG tube became contaminated by radioiodine secreted in the gastric mucosa during therapy and this radioactivity subsequently decayed with an increased effective half-life relative to the stomach, leading to the apparent hot spot.

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Systemic radionuclide therapy with radioiodine for thyroid cancer is a long-established and routine procedure worldwide [1]. It is common practice to take advantage of the 364 keV gamma emissions from I-131 to perform post-therapy scintigraphic imaging [2]. In general, whole body planar images are acquired, often with additional static views of the neck. The principal uses of post-therapy imaging are to verify the uptake in the tumour and to screen for iodine-avid metastatic disease. As such, any suspicious hot spot must be investigated and single photon emission CT (SPECT)/CT is becoming an increasingly common tool to aid in the localisation and characterisation of such lesions [3]. In this case report, we present an unusual finding in which SPECT/CT was used to localise an abdominal hot spot in a patient with a percutaneous endoscopic gastrostomy tube *in situ*.

Case report

An 80-year-old male with a history of thyroid cancer, a stimulated thyroglobulin of $22.1 \mu\text{g l}^{-1}$ and a CT diagnosis of recurrent cervical lymph node disease and lung metastases was referred for a therapeutic administration of radioiodine. The patient had an unsafe swallow due to the pressure of lymph node enlargement on the recurrent laryngeal nerve and was fed via a percutaneous endoscopic gastrostomy (PEG) tube. In our centre, radioiodine is routinely administered orally in the form of a capsule (Theracap; GE Healthcare, Amersham, UK). In this case, it was clear that liquid administration would be required.

I-131 radiopharmaceuticals are thought to adsorb readily onto plastic materials, although there is a lack of published data on this [4]. To avoid adhesion of the therapeutic agent to the PEG tube, we elected to infuse the radioiodine via an intravenous cannula.

A dosimetric imaging protocol was followed in which whole-body scans were acquired immediately after infusion and at 4.5, 21, 45, 141 and 213 h post-infusion. The whole-body images were acquired on our GE Infinia Hawkeye gamma camera (GE Medical Systems, Slough, UK) using high energy general purpose (HEGP) collimators with a matrix size of 256×1024 and a bed speed of 20 cm min^{-1} .

The sequential whole-body images showed normal physiological uptake of radioiodine in the salivary glands, stomach and bladder (Figure 1). No significant radioiodine uptake was seen in either the remnant thyroid bed or the lungs. In the image taken at 141 h, an area of increased uptake overlying the stomach was observed, which persisted in the images acquired at 213 h. In order to clarify the origin of this uptake, a SPECT/CT study was requested. This was performed at 357 h (15 days) post-infusion, again on our GE Infinia gamma camera with HEGP collimators. As a result of the low count rate, the SPECT images were acquired on a 64×64 matrix with 64 projections at 60 s per projection. The images were reconstructed using ordered subset expectation maximisation (10 subsets, 2 iterations, Hann post-filter with critical frequency 0.9) with scatter and attenuation correction. Single-slice localisation CT images were acquired at 140 kV and 2.5 mA and reconstructed with a slice thickness of 10 mm; these images showed an anatomically normal stomach wall. This was confirmed by comparison with a diagnostic quality CT scan performed 4 weeks earlier, making a focal metastatic deposit unlikely. These images are shown in Figure 2.

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Figure 1. Sequential whole-body images at (a) 0, (b) 4.5, (c) 21, (d) 45, (e) 141 and (f) 213 h post-administration showing localised retention of radioiodine in the abdomen.

Figure 2. (a) Single photon emission CT/CT image taken at 357 h post-administration. The transaxial slice containing the most intense uptake is shown together with (b) the corresponding slice from the diagnostic CT acquired 4 weeks earlier, showing the site of the percutaneous endoscopic gastrostomy tube insertion. The close correlation between these images indicates that the uptake is at the position of the inner bumper against the internal stomach wall.

Discussion

The abdominal focal uptake is seen to correspond to the junction of the PEG tube with the stomach wall. Metastatic spread of oropharyngeal tumours to the site of PEG tube insertion have been reported with direct seeding thought to be the mechanism [5]. However, there have been no reports of metastatic spread of thyroid cancer to the site of an indwelling PEG. Therefore, we hypothesise that the radioiodine retention is due to contamination of the PEG itself, particularly in view of the anatomically normal stomach wall seen on both the low- and high-resolution CT images. Figure 3 shows a diagram of PEG placement in the stomach. This consists of a catheter held in place by two “bumpers”—one on the external skin surface and the other inside the stomach wall. The internal bumper is in contact with the gastric mucosa, a site where physiological radioiodine secretion is known to occur [6]. We postulate that this physical contact facilitates the adsorption of radioiodine onto the plastic material of the bumper. Furthermore, it is possible that any reflux of radioactive chyme from the stomach into the PEG catheter might also result in radioiodine adsorption onto the catheter itself proximal to the stomach.

Some of the radioiodine will become fixed onto the plastic of the PEG tube. However, it is also likely that some removal of this adsorbed radioiodine will occur owing to the passage of liquid food through the PEG. The greater contribution of the physical half-life of the isotope at the PEG site will lengthen the effective half-life relative to the surrounding gastric mucosa. Hence, when

viewed on sequential images, the PEG appears as a persistent hot spot against a reducing background, mimicking the appearance of a metastasis. Figure 4 shows the counts obtained in regions of interest placed over the PEG site and the stomach as a whole on the sequential whole-body images. The solid lines show exponential fits to the data points, with r^2 values of 0.969 and 0.977. The calculated effective half-lives from these curves are 32 h for the PEG tube and 23 h for the whole stomach.

The patient has been followed up since therapy and his thyroglobulin level at 4 months post-treatment fell to

Figure 3. Diagram of percutaneous endoscopic gastrostomy tube placement, showing the position of the bumper against the internal stomach wall. Adapted from [7].

Figure 4. Graph of the counts in regions of interest drawn over the hot spot and the whole stomach on the sequential whole-body images (inset). In order to limit the effects of dead time, the first two scans were omitted from the analysis. The calculated r^2 values and effective half-lives are shown on the graph. PEG, percutaneous endoscopic gastrostomy.

$3.0 \mu\text{g l}^{-1}$. Although the patient is now able to swallow soft foodstuffs, there are no immediate plans to remove the PEG tube and therefore no *ex vivo* verification of the radioiodine contamination can be performed at this stage. The patient will continue to be followed up and the site of the PEG tube monitored closely. It should be noted that if the PEG was removed shortly after radioiodine therapy, it would necessitate disposal as radioactive waste and the removal of the tube would require the involvement of the nuclear medicine department.

Conclusion

This case has shown that radioiodine retained on PEG tubes can lead to ambiguous hot spots on post-therapy whole-body images, which may mimic the appearance of metastatic disease. The importance of SPECT/CT has been demonstrated both in clarifying the origin of such uptake and of detailing normal anatomy in such cases. The removal of PEGs shortly after radioiodine therapy may represent a radiation hazard and appropriate waste disposal protocols should be followed.

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