Radiation dose of caregivers could be reduced in thyroid carcinoma patients requiring high dose of radioactive iodine: A case report

Case Report

Lebriz Uslu-Beşli[1], Mustafa Demir[1], Nami Yeyin[1], İffet Çavdar[2]

[1]Department of Nuclear Medicine, Cerrahpaşa Faculty of Medicine, Istanbul University, Istanbul, Turkey
[2]Nuclear Physics Department, Faculty of Science, Istanbul University, Istanbul, Turkey

(Received 11 December 2015, Revised 15 May 2016, Accepted 16 May 2016)

ABSTRACT

Undesired radiation exposure to caregivers is an important problem in radioiodine therapy in thyroid carcinoma patients, especially when patient is non-ambulatory. Special precautions are needed to keep the exposure to caregivers low when higher dose of radioiodine is necessary.

Here we present a case-report of a 74-year old male patient with papillary thyroid carcinoma with local invasion and distant metastases, who received 9250 MBq I-131. The patient was confined to bed and needed special assistance for nasogastric tube and urinary catheter. Two family members helped the patient for daily care under the supervision of nursing staff. Caregivers were instructed for radiation protection and lead aprons, lead collars, two pair of gloves and lead screen were used during close contact with the patient. The patient was given daily amount of 4 liter water to increase the urinary excretion of radioiodine. The patient stayed at the hospital for 2 days and discharged when dose rate fell below 30 µSv/h at 1 m. Caregivers at home used lead aprons and lead collars for 3 more days. Cumulative radiation dose measured at the 5th day for two caregivers was 1320 µSv (264 µSv/day), which is under the safety limit of 5 mSv given by ICRP.

Key words: Thyroid neoplasms; Thyroid cancer; Radioiodine; Caregiver; Radiation protection

Iran J Nucl Med 2016;24(2):144-146
Published: July, 2016
http://irjnm.tums.ac.ir

Corresponding author: Mustafa Demir, PhD, Department of Nuclear Medicine, Cerrahpaşa Faculty of Medicine, Istanbul University, Cerrahpaşa, Fatih, Istanbul, Turkey. E-mail: demirm@istanbul.edu.tr

INTRODUCTION

Following radioiodine therapy for thyroid carcinoma radiation protection measures are necessary to protect the public, caregivers and family members from ionizing radiation after discharge of the patient from the hospital. These precautions are especially important to limit the radiation dose received when the patient is not ambulatory and requires special assistance. According to the International Commission on Radiation Protection (ICRP) annual public dose limit is 1 mSv. Adult family members and caregivers are allowed to receive a higher dose of 5 mSv per episode provided that the average dose for consecutive 5 years does not exceed 1 mSv. There are similar dose constraints for European Commission (EC), which allows 3 mSv for family members aged 10-60 and 15 mSv for those aged >60. For non-ambulatory patients, hospital stay is generally prolonged in many centers to limit the radiation dose for family members.

Here we present a case with thyroid carcinoma, who is confined to bed and needed special assistance and required radioiodine therapy.

CASE REPORT

A 74 year-old male patient had fine needle aspiration biopsy from left supraclavicular lymph node, which revealed thyroid carcinoma metastasis. F-18 FDG PET/CT showed hypermetabolic mass at left thyroid lobe and an additional thyroidal mass with tracheal invasion. Left supraclavicular and right mediastinal lymph node metastases, multiple lung metastases, bilateral iliac bone metastases were also present on PET/CT. The patient was recommended a debulking surgery for thyroidal mass invading trachea and for resection of supraclavicular and mediastinal lymph node metastases. Postoperative pathology result revealed 5 cm sized papillary thyroid carcinoma with undifferentiated carcinoma component (PT4aN1M1). Serum TSH level was 42 µIU/ml, thyroglobulin was 133.66 ng/ml and anti-thyroglobulin was 21.48 IU/ml. Because the patient was in high-risk group, 9250 MBq (250 mCi) radioiodine therapy was recommended.

The patient had nasogastric tube and foley catheter and he was confined to bed. Two family members were helping the patient for daily caregiving and the patient did not accept to replace them with healthcare providers during hospital stay. Therefore family members were informed about ionizing radiation and protective measures. Daily rotation of caregivers was provided to distribute the dose to be received between two family members. They did not stay with the patient all day, another room was provided for family members to stay at the department. The patient could call the caregivers when necessary. Additional radioactivity protection precautions would be necessary for caregivers during nasogastric tube feeding and emptying drainage bag of urinary catheter after radioiodine administration. Lead aprons with 0.3 mm thickness, lead thyroid collars and two pairs of gloves were used for radiation protection during daily caregiving. An additional 0.7 cm lead screen was used when a caregiver had to stay with the patient. Two caregivers carried optically stimulated luminescence (OSL) dosimeter under lead apron to measure their radiation dose. External dose rate of the patient was measured using Geiger-Müller (GM) probe (Eberline ESP-2, NM, USA) from mid-thorax at 1 m distance.

The patient was given radioiodine solution from the nasogastric tube. He was also given daily amount of 4 liter water to increase the urinary excretion of radioiodine. The urine was collected in the drainage bag and emptied into the toilet by caregivers. Urine is finally collected into the radioactive waste tank for decay. The patient stayed in the hospital room for 2 days and discharged at the 3rd day when dose rate <30 µSv/h at 1 m was achieved. Caregivers carried OSL dosimeter, lead aprons and lead collars for 3 more days at home. The caregivers were advised to take radiation safety precautions at home. Post-radioiodine whole body scan was performed at the 5th day (Figure 1).

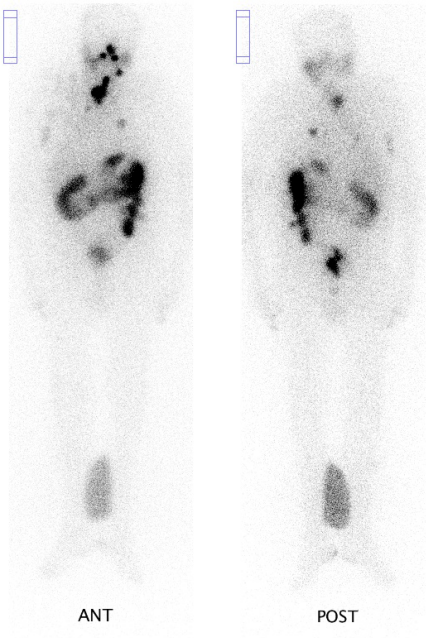

Fig 1. Post-radioiodine whole-body scan performed 4 days after 250 mCi I-131 administration. Remnant thyroid tissue showed intense radioiodine uptake. Further uptake on metastatic left cervical lymph nodes and multiple lung metastases were also detected.

24 hours after radioiodine administration dose rate of the patient was measured to be 78 µSv/h at 1 m. Dose rate decreased to 22.8 µSv/h at 48th h and 0.95 µSv/h at the 5th day (120th h). For two caregivers cumulative radiation dose measured at the 5th day was 1320 µSv (264 µSv/day).

DISCUSSION

Radioiodine treatment for thyroid carcinoma is a potential source of radiation exposure for caregivers who provide support for patients during and after the treatment. According to the legal regulations in our country patients are not discharged until dose rate <30 µSv/h at 1 m from midlevel of thorax is achieved. To limit the radiation exposure, patients stay in special lead-lined hospital rooms and their urine is collected in tanks for decay. According to the International Commission on Radiological Protection (ICRP) annual public dose is 1 mSv and adult family members who are responsible for caregiving can receive up to 5 mSv provided that the average dose for consecutive 5 years does not exceed 1 mSv [1]. After patients leave the hospital, they are advised to limit the time spent with their relatives, restrict the travel time to maximum 8 hours in a private car, keep a distance in between, sleep in separate beds, and avoid close contact with children to reduce the exposure [2]. Ramírez-Garzón et al reported that mean effective dose received by caregivers could increase to 2.21±1.32 mSv in families where precautions could not be applied, instead of 0.07±0.04 mSv in families where the precautions were seriously taken [3]. Mean external radiation dose for family members was 0.12±0.1 mSv for thyroid carcinoma patients who were released from the hospital 3-4 days after radioiodine administration [4]. In patients who received outpatient based 1110 MBq radioiodine, cumulative effective dose of caregivers after one week was reported to be 0.11±0.08 mSv [5].

Radiation exposure is a greater concern when the patient is non-ambulatory and therefore requires special assistance. Cumulative dose to nursing staff increased from 0.08 mSv for a self-caring patient to 6.3 mSv for a totally helpless patient [2]. Greaves et al reported that the nursing staff caring for a helpless thyrotoxic patient who received 800 MBq radioiodine could receive up to 650 µSv in 3 days [6]. The nursing staff who routinely care for patients receiving radioiodine had to be excluded from the care of their non-ambulatory patient to restrict their over-exposure. In our case, where a high dose of radioiodine was necessary, nursing staff of the nuclear medicine service was also excluded from daily care to limit their exposure. The patient preferred the family members who did not receive radiation before to help him with daily care. Nursing staff supervised them during their stay. A median effective dose of 145 µSv/day was reported to be measured in the nursing staff of the thyrotoxic case who received 800 MBq radioiodine [6]. In our case, who received 9250 MBq radioiodine, cumulative radiation dose for two family members was 1320 µSv after 5 days (264 µSv/day). This dose is under general dose constraint of 5 mSv for family members.

CONCLUSION

This case shows us that under radiation safety precautions caregiving could be maintained safely to helpless patients requiring high dose of radioiodine. Undesired radiation exposure to caregivers could be kept to minimum when adequate radiation protection measures are applied.

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