

MS01: ปริมาณรังสีที่บุคคลในครอบครัวได้รับจากผู้ป่วยที่เข้ารับการรักษามะเร็ง ไทรอยด์ในโรงพยาบาลด้วยไอโอดีน-131: กรณีศึกษา

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บทคัดย่อ

การรักษามะเร็งไทรอยด์ด้วยไอโอดีน-131 ความแรงรังสีสูงในโรงพยาบาล กรณีที่ผู้ป่วยไม่สามารถเข้าห้องน้ำด้วยตนเองได้ จะทำให้ผู้ให้การดูแลมีความเสี่ยงจากการแผ่รังสีจากถุงปัสสาวะของผู้ป่วยที่ได้รับการสอดใส่สายสวนปัสสาวะก่อนกินไอโอดีน-131 ถุงปัสสาวะจะถูกเก็บไว้ในถังตะกั่วกำบังรังสี แล้วถูกนำไปทิ้งทุก ๆ 4 ถึง 6 ชั่วโมงในวันแรก และ 8 ถึง 10 ชั่วโมงในวันต่อ ๆ มา หลังจากบุคคลในครอบครัวทำหน้าที่ให้การดูแลช่วยเหลือผู้ป่วยขณะพักอยู่ในโรงพยาบาลได้รับคำแนะนำแนวทางการดูแลความปลอดภัยทางรังสีแล้ว จะได้รับเครื่องวัดรังสีชนิดพกพาติดตัว สามารถอ่านค่าการได้รับรังสีได้โดยตรง มีการบันทึกตลอดเวลาสามวันที่ผู้ป่วยพักอยู่ในโรงพยาบาลและวัดต่อเนื่องอีกสองสัปดาห์เมื่อกลับบ้าน ผลการวัดปริมาณรังสีสะสมตลอดเวลา 16 วัน เท่ากับ $650 \mu\text{Sv}$ ประมาณร้อยละ 44 ($288 \mu\text{Sv}$) ได้รับภายใน 24 ชั่วโมงแรก มากกว่าร้อยละ 70 ($462 \mu\text{Sv}$) ภายในเวลาใน 72 ชั่วโมงแรก ประมาณร้อยละ 25 ($162 \mu\text{Sv}$) ได้รับจากการเทปัสสาวะทิ้ง ปริมาณรังสีส่วนใหญ่ ($488 \mu\text{Sv}$) ได้รับจากการใช้เวลาอยู่ใกล้ขณะดูแลผู้ป่วย แต่ยังคงอยู่ในขีดจำกัดไม่เกิน 1 mSv ต่อปีและต่ำกว่าค่ากำหนด 5 mSv ในปีใดๆ สำหรับการได้รับรังสีในกรณีจำเป็นเช่นจากการดูแลผู้ป่วย

คำสำคัญ: การรักษาด้วยไอโอดีนรังสี ผู้ป่วยมะเร็งไทรอยด์ ผู้ให้การดูแล ปริมาณรังสี

Radiation Dose to Family Member of Hospitalized Patient Receiving I-131 Therapy for Thyroid Cancer: Case Study

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Abstract

During high-dose I-131 therapy, hospitalized patient who is unable to walk to the bathroom is at risk of radiation burden to comforter from excreted urine. Foley catheter is usually placed in the patient before I-131 administration. The urine was collected and housed in lead shielding, emptied every 4 to 6 hours on the first day, and every 8 to 10 hours on subsequent days. After specific instructions with regard to radiation safety, family member designed as the caregiver of patient was provided an electronic personal dosimeter to directly measure

radiation dose for three days in isolated hospitalization and two more weeks at home. The caregiver recorded time spent in contact with the patient and activities performed during these times. Total accumulative dose for 16 days was 650 μSv of which 44% (288 μSv) was from the first 24 hours and more than 70% (462 μSv) during the first 72 hours, and about 25% (162 μSv) from emptying urine bags. Most of the dose received (488 μSv) was from attending time spent in the vicinity of the patients. However, this was not exceeding the constraints of 1 mSv/y and well below the limit of 5 mSv in any one year for exposed caregiver and comforter.

Keywords: Radioiodine treatment, thyroid cancer inpatient, caregiver, radiation dose

1. Introduction

Therapeutic doses of I-131, range from 3.7 to 7.4 GBq (100-200 mCi) has been used to ablate thyroid remnant or to treat metastatic disease in patients with thyroid cancer for decades. After a therapeutic administration of I-131, the patient becomes a potential source of high radiation exposure to others. The patient must be hospitalized until their body content of radioactivity falls below 1110 MBq (30 mCi) or the measured exposure rate from the patient is less than 5 mR/h at one meter¹. During hospitalization the external exposure to others is directly related to the quantities of administered activity, its effective half-life and the amount of time spent in the proximity to the patient particularly in the early hours and few days after treatment. Exposure to the individuals that may come in contact with a treated patient should be prevented or reduced as far as is reasonably possible. Radiation precautions are used to minimize external exposure and the spread of contamination from urine, saliva and sweat^{2,3}. Family members of a patient who may not willing to support or comfort the patient was treated as third persons and are automatically subjected to the dose limits for the general public, 1 mSv in a year. However, the International Atomic Energy Agency Basic Safety Standards⁴ states that this dose limits for members of the public do not apply to exposures of individuals who are knowingly and willingly helping in support and comfort of in-patients or out-patients undergoing medical diagnosis or treatment.

In this preliminary study, radiation dose to caregiver attending a non self-supporting patient undergoing radioiodine therapy was monitored while patient was hospitalized for treatment. Measurement was extended to two more weeks after patient was released from the hospital to confirm that the advised precautions successfully maintains the dose below the regulatory limits recommended by the International Commission on Radiological Protection (ICRP)⁵.

2. Materials and Methods

2.1 Patient

We have experimentally measured radiation burden to caregiver during high dose radioiodine therapy of hospitalized patient who was suffered from multiple bone metastases, non self-supporting, unable to walk to the bathroom and her 51-y old daughter volunteered as the caregiver. Patient was admitted to a lead-shielded room of approximately 16 m² at Siriraj Hospital Medical School to received 7.4 GBq (200 mCi) of I-131. The room is also accommodated with 2 extra lead barriers, each of 1.2 x 0.8 m² and 2 cm thick (7HVL). Foley catheter is placed in the patient before I-131 administration. The urine was collected and housed in lead shielding, emptied every 4 to 6 hours on the first day, and every 8 to 10 hours on subsequent days.

2.2 Caregiver

There is no separate room for caregiver. Radiation precautions are used to minimize personal exposure and the spread of contamination^{2,3}. The caregiver was instructed to stay behind the shields. After specific instructions with regard to radiation safety, she was provided an electronic digital dosimeter (PDM 112) to directly measure radiation dose received, on the basis of realities of daily living, during three days in the hospital and additional two more weeks upon returning home. Radiation safety team taught the caregiver how to wear and use the device and to record time spent in contact with the patient and activities performed during these times. Thyroid burden measurement was performed within 72 hours following administration of therapeutic dose to the patient. An Atomlab 950 thyroid uptake system was used.

3. Results and Discussions

Total accumulative dose during 16 days was 650 µSv of which 44% (288 µSv) was from the first 24 hours and more than 70% (462 µSv) during the first 72 hours, and about 25% (162 µSv) from emptying and replacing urine bags. Most of the dose received (488 µSv) was from attending time spent in contact to the patients. The risks from internal contamination of others have been shown to be less significant than those from external exposure and an incorporation of large activities of I-131 that might cause hypothyroidism in an adult caregiver is extremely unlikely⁶. In this study, thyroid measurement did not show any measurable uptake. Dose received from patients travelling after radioiodine therapy rarely present a hazard to other passenger if travel times are limited to a few hours. Our patient was released with the retained activity of 200 MBq (5.4 mCi),

caregiver received only 10 μSv during 1 hour travel time. The radiation dose received in μSv as a function of time is shown in Fig. 1 and dose received from emptying and changing urine bags is shown in Fig. 2. This was not exceeding the limit of 1 mSv/y and well below the limit of 5 mSv in any one year for exposed caregiver and comforter.

When the treatment is carried out on an in-patient basis, nurses in the isolation ward will continuously received high radiation burden. Barrington et al.⁷ reported that the cumulative dose to nursing staff depended on patient mobility and was estimated at 0.08 mSv for a self-caring patient to 6.3 mSv for totally helpless patient. If no restriction is applied, as high as 132 mSv may be obtained. Williams and Worward⁸ estimated an effective dose of 3.4 mSv over 7 days received by nursing staff on dealing with helpless patient undergoing 1 GBq radioiodine therapy.

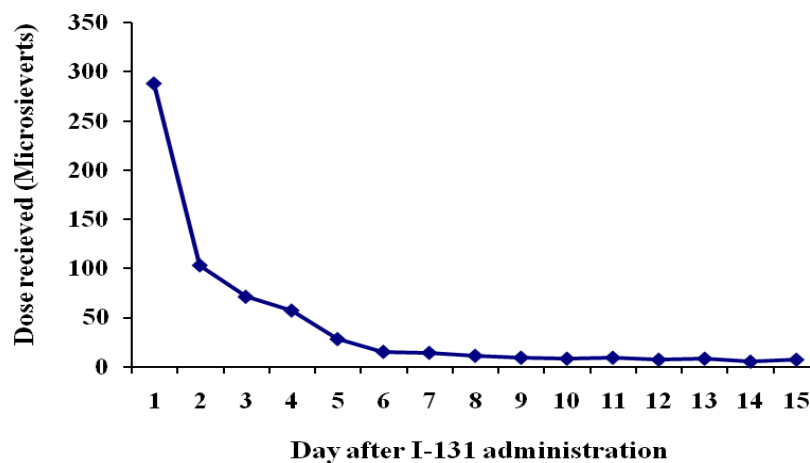


Fig 1 Total dose received by caregiver of patient treated with I-131 during 2 weeks of observation.

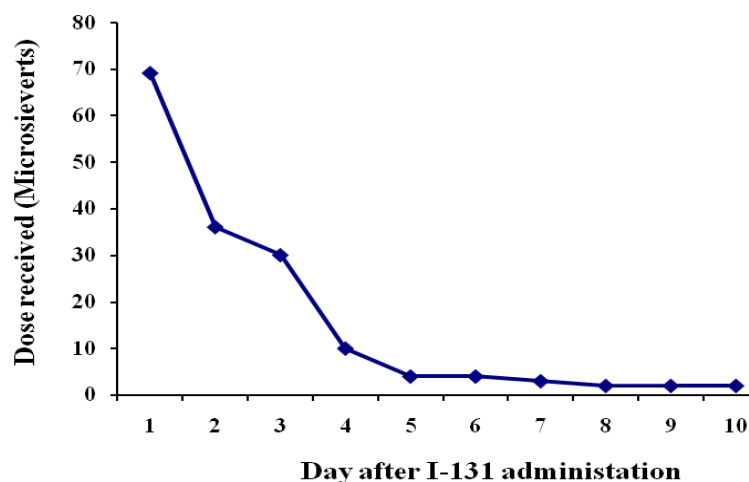


Fig 2 Radiation burden to caregiver from emptying urine bags during 10 days of observation.

After the US Nuclear Regulatory Commission (NRC) revised the patient release regulations, allowing for out-patient administration of larger activities of I-131 than previously permitted⁹, many publications reported radiation dose received by family members and caregivers from out-patient I-131 therapy, ranged from 0.01 to 1.09 mSv (average 0.24 mSv)¹⁰, 0.1 to 3.54 mSv (average 1.16 mSv)¹¹. Marriott et al.¹² reported a maximum dose of 283 μ Sv received by caregivers during high dose out-patient radioiodine therapy of which one-third was received during the journey home from the hospital. If the family member is accompanied with patient to provide support and comfort while patient is confined in hospital, nursing staff caring for in-patients will receive a much lower dose because of their decreased exposure to the patient.

Since these exposures are unlikely to recur frequently in any family, the ICRP⁵ recommendation excluded them from the 1 mSv annual limit so long as they are likely to remain below 5 mSv and can be averaged to 1 mSv/y or less over 5 years. It is the responsibility of the treatment team to ensure that the dose limits and dose constraints are not exceeded when multiple therapies are undertaken.

4. Summary

In our case study, I-131 dose to caregiver of a non self-supporting hospitalized patient undergoing radioiodine therapy were well below the recommended limit given by the International Commission on Radiation Protection (ICRP) which has relied upon the dose limit of 1 mSv/y for the public and the dose constraint of 5 mSv/episode for relatives, visitors and caregivers.

5. Acknowledgments

The authors thank the patient's daughter for her valuable help in recording radiation doses received during the whole period of observation in the hospital and on returning home.

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