Radiation doses vs patient’s life styles

Radiation doses from 131I treated hyperthyroidism patients’ vs life style-Asurvey

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ABSTRACT

The Radioactive Iodine is widely used for the treatment of various thyroid disorders. The patients undergoing such treatments are advised to restrict their social and work related activities to limit radiation exposures to others. The present work describes the results of a structured survey conducted on patients visiting Institute of Radiotherapy and nuclear Medicine (IRNUM), Peshawar, for the thyrotoxicosis treatment. The patients were asked about their housing conditions, family set up, number of kids, travelling mode and time back home from the hospital. The radiation doses to the other people with whom they might come in contact in their living environment were estimated. The radiation doses to others at one meter from the patients were calculated as 0. 76, 1. 53, 2. 29, 3. 06, 3. 82 and 4. 58mSv. The results of the survey indicate that the radiation protection advice and other regulatory requirements need to be reviewed keeping in view individual patient’s circumstances.

INTRODUCTION

The radioactive iodine (RAI) is widely used for the treatment of various thyroid disorders since long. The differentiated thyroid cancer (DTC) is treated by admitting the patients in hospital where as hyperthyroidism patients are treated on out patient basis in most of the countries (1-4). The

safety issues for the patients, their families, comforters, hospital staff and the general public arise with either treatment approach. The radiation hazards are more in case of hyperthyroidism treatment than the DTC treatment due to shorter effective half life of the 131I in the later application. Therefore at the time of release of the patient from medical confinement, the retained radioactivity in DTC patients is much lower causing low risk of radiation exposure to other people. In case of thyrotoxicosis treatment the administered radioactivity is much lower as compared to DTC treatment but radiation doses to others are more due to high uptake of RAI by these patients (5-8). The patients undergoing such treatments are advised to restrict their social and work related activities to reduce radiation exposure to others when they return to their families in community (9-16). This radiation protection advice is usually based on residual activity or radiation exposure level and is not specific to an individual patient circumstances or socioeconomic condition. These advices are usually formulated by the developed countries and are adopted as such in most of the developing countries. In actual practice the compliance to the protection advice depends on socioeconomic conditions and the life style of the patients.

Therefore keeping in view this aspect of RAI treatments, an interview based structured survey was conducted on patients visiting our hospital for the treatment of thyrotoxicosis.

The patients were asked about their housing conditions, family/home set up, number of kids, mode of travelling and travelling time to back home from the hospital. The radiation doses to the other people with whom they might come in contact in their living environment

MATERIAL AND METHODS

The patients were asked about their housing conditions, family set up, number of kids and travelling periods back home. The total number of patients inducted in the present survey was 419. The data collected was tabulated and reviewed for completeness. A calibrated dose of 131I (185-1106MBq) was administered to the patients. The exposure rate from the patient was measured at a distance of one meter from standing position with a hand-held pressurized battery operated β γ survey meter, Victoreen Model 450P, calibrated from secondary standard dosemetry laboratory, Islamabad. The dose rate was recorded in units of μSvhr-1. The patients were instructed to sleep alone, drink fluids liberally and avoid prolonged close personal contact with others for the first 2 days. The patients and familymembers were told that they could resume normal activities thereafter (9-12). The estimated radiation doses to the maximally exposed person were calculated using the formula given in equation 2 (14).

RESULTS

There were 385 (93%) patients residing in joint and 29 (07%) in separate family system Table 1. It was found that 15. 27 % of the patients were male and 84. 73% females with age wise distribution as shown in Table 2.

The measured hospital leaving dose rate at one meter from the patients were 5. 7, 11. 0, 15. 7, 18. 7, 23. 0 and 28. 0μSvh-1 for administered RAI activity of 5, 10, 15, 20, 25 and 29. 9mCi respectively. The corresponding radiation doses to others from exposure to the patient at one meter using

occupancy factor of 0. 25 were calculated as 0. 76, 1. 53, 2029, 3. 06, 3. 82 and 4. 58mSv Table 3.

They survey showed that 4. 77, 17. 66, 22. 91, 24. 10, 12. 66 and 17. 90% patients had accommodation consisting of one, two, three, four, five and more than five rooms respectively Table 4.

It was observed that 78. 04% patients used public transport and 21. 96% used private transport for back home after RAI administration. The radiation doses to others during travelling were estimated using occupancy factor of 0. 1m and 1m distance plotted versus travelling time of the patient from hospital to back home Figure 1 and Figure 2 respectively.

It was also observed that 1. 67% of the patients had no sanitary arrangements at home and they used open space in the fields as toilet. The patients residing in localities where there is comparatively better sanitation arrangements had one (31. 74%), two (36. 04%), three (17. 42%) and more than three (13. 13%) toilets available Table 5.

In addition 11. 93% of the patients had no kids where 10. 74% lived in joint family system and 1. 19% as separate. The survey showed that 88. 7% of the patients had kids and 82. 33% of these lived in joint family system where as 5. 73% lived separate. The number of kids and the family status showed that 17. 18%, 31. 50% and 33. 65% patients had 1-3, 4-6 and more than 6 kids respectively lived in joint family system while 2. 86%, 1. 91% and 0. 95% patients had 1-3, 4-6 and more than 6 kids respectively and they used to live in separate family system Table 6.

DISCUSSION

The patients treated for thyrotoxicosis with RAI (131I) are advised certain restrictions on behavior in order to ensure the radiation safety of all other individuals with whom they may come into contact. Generally it is assumed that the patients are unlikely to create a hazard to other persons. A dose limit of 5mSv and 1mSv had been recommended for these peoples depending upon the nature and type of their interaction with the patient (17). The compliance to the safety instructions depend upon patient’s literacy level, decision making capacity, health education, grasping and understanding disclosure of treatment in general and patient’s socioeconomic conditions and life styles in particular(18, 19).

The over all literacy level of the survey region is 37. 26 % (20). Literacy level reflects the ability of the patients to comprehend that they emit detectable levels of radiation for specified period of time after their treatment which are hazardous for other peoples. It was observed that 93% of the patients inducted in the survey used to reside in joint family system and 07% lived in separate system Table 1. This aspect coupled with the low literacy level puts emphasis on the patients receiving treatments to comply with the instructions strictly to limit radiation exposure to others.

The restriction on mode of travelling back to home is important factor in RAI treatment especially when 78. 96% of the patients used public transport to back home from hospital. It is practically difficult to measure radiation doses to other passengers traveling in the same vehicle. The measured hospital leaving dose rate at one meter from the patients suggest that the time

restrictions to travel by private transport (at 1m distance) are not required, although they should not sit immediately adjacent to another passenger, accompanying person or driver Table 3.

Similarly restrictions would not be required for public transport (0. 1m distance) for one hour journey. It was observed that radiation doses to others at 1m and 0. 1m with administered 131I radioactivity of 185, 555 and 1106MBq increases linearly with the travelling time Figure 1 & 2. The patients needing greater travelling time back home should use private transport after RAI administration. Therefore regulatory authorities need to reassess the situation with respect to private or public mode of travelling while recommending discharge limits for RAI treatments. The radiation doses from the exposure to the patient to total decay (t=∞) at one meter using occupancy factor of 0. 25 for RAI administered were well within recommended dose limit of 5mSv for adult comforters Table 3. However for patients residing in single room accommodation, with kids and joint family system, the dose limit of 1mSv is unlikely to be adhered. This aspect becomes more important where a very large percentage of the patients (88. 07%) had kids and 82. 33% of those used to live in joint family system as observed in the present survey Table 6. The sanitary conditions of the patients at home are important to protect family members from radioactive contamination and associated external radiation exposure. It was observed that patients having better sanitation arrangements would not pose radiation related problems.

However patients having no proper sanitation (1. 67%) are source of concern for the communities where they reside Table 5.

The trends observed indicate that the patients with single room accommodation, having kids and joint family system need strict compliance to radiation protection advice to restrict radiation doses to the immediate family members. Therefore RAI treatments need to be carried out keeping in view patient’s living conditions and life styles.

CONCLUSION

The radiation protection advice and regulatory requirements need to be formulated keeping in view patient’s socioeconomic, life style and living conditions. It needs to be reviewed depending upon individual patient’s circumstances.

Table 1 Family Status (N= 419)

Status No of patients (%)

Joint Family 390 (93)

Separate Family 29(07)

Table 2 Age and Sex Distribution of Patients

Age No. of Patients (%)

<16 3(0. 7)

17 to 28 36(8. 59)

29 to 40 161 (38. 42)

41 to 50 119 (28. 4)

51 TO 60 67 (15. 9)

> 60 33 (7. 8)

*15. 27 % of patients are males

** 84. 73 % of patients are females

Table 3 131I administered Vs Average Radiation Doses

S. No

131I activity (mCi) No. of patients (%)

Average leaving

dose rate at 1

meter

(µSv/hr)

Average Dose*

to others at 1

meter

(mSv)

1 05 12 (2. 88) 5. 7 0. 76

2 10 18 (4. 3) 11 1. 53

3 15 99 (23. 62) 15. 7 2. 29

4 20 233 (55. 6) 18. 7 3. 06

5 25 47 (11. 21) 23 3. 82

6 29. 9 10 (2. 3) 28 4. 58

* Average doses to total decay (t=∞) to other individual exposed to the patient at one meter using occupancy factor of 0. 25.

Table 4 Status of Patients in Relation to No. of Rooms in Joint/ Separate System

No. of rooms

in home

No. of Patients

(%)

Patients

living in

Joint Family

System

Patients

living in

Separately

1 20(4. 77) 18 2

2 74(17. 66) 69 7

3 96(22. 91) 90 7

4 101(24. 10) 96 4

5 53(12. 66) 46 4

More than 5 75(17. 90) 71 5

Table 5 Sanitary Status of Patients

No. of Toilets in home of Patients No. of Patients (%)

Open without flush 07(1. 67)

With one flush 133(31. 74)

With two flush 151(36. 04)

With three flush 73(17. 42)

More than three flush 55(13. 13)

Table 6 Kids Status Vs Family System

Figure 1 Radiation

Doses (mSv) at 0. 1m

Vs Travelling Time

(Hrs)

Kids Status Joint Families (%) Separate Families (%)

Without Kids

50(11. 93)

45(10. 74) 05(1. 19)

With Kids 369(88. 07) 345(82. 33) 24(5. 73)

Up to 3 Kids

4 to 6 Kids

7 and above

72(17. 18)

132(31. 50)

141(33. 65)

12(2. 86)

08(1. 91)

04(0. 95)

Figure 2 Radiation Doses (mSv) at 1m Vs Travelling Time (Hrs)