



A practical approach on radioprotection in the radioiodine treatment for thyroid cancer

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ABSTRACT

There are several protocols for the treatment and follow-up of differentiated thyroid cancer. All of them gather evidence on the evolution and treatment and try to establish a standard. However, there are few occasions in which this issue is addressed from the standpoint of radiological protection, as the ICRP 94 and TECDOC 1608. The focus of this work was to demonstrate that simple actions in the routine of workers in a Nuclear Medicine Service interfere positively in the radiation protection of all those involved in the patient's care, also optimizing their well being during the procedure. In the current model, the patient participates in an interview with nurses, doctors and physicists before admission and receives written and verbal information about the procedures in order to diminish his anxiety and clarify possible doubts. In all the cases under hospital care there were no instances of high exposure (above 1mSv/month or 6 mSv/year) among the staff. With the participation of all involved, there was an escalating reduction of complications generated by the patient's anxiety, in waste production, providing better comfort during hospital care and minimization of occupational hazard affecting the staff in charge of the patient's room maintenance after hospital leave.

Keywords: medical physics, radioiodine, radioprotection.

1. INTRODUCTION

Thyroid cancer is the most common malignant neoplasm of the endocrine system and occupies the eighth position in the ranking of cancers that affect women worldwide. The most common types are: papillary carcinoma and follicular carcinoma, which together account 90% of thyroid cancers. In Brazil 1,570 new cases of male thyroid cancer and 8,040 for females are estimated for each year of the 2018-2019 biennium, with an estimated risk of 1.49 cases per 100,000 men and 7.57 cases per 100,000 women, ranking 13th and 5th in the primary malignant neoplasm, respectively (disregarding non-melanoma skin tumors) [1].

As their diagnoses and treatments are very similar, papillary and follicular can be grouped under a common denomination Differentiated Thyroid Cancer (DTC), which allows to simplify their study [2, 3, 4]. Most cases of DTC (85-90%) are characterized by an indolent and low risk of morbidity and mortality considering an appropriate treatment. They are more common in women (3: 1) between the 3rd and 4th decade of life [4].

Radioactive iodine (¹³¹I) procedures have been introduced for thyroid diseases treatments since 1946 by Seidlin et al. [5] and are the most important source of public and relatives radiation exposures from patients who have been received unsealed radionuclides [6].

Members of the public and health workers may be exposed to ionizing radiation through contact with patients undergoing the above mentioned treatments. This can occur in two ways: in the first, the patient acts as a source of gamma radiation which causes the risk of third-party exposure. In the second, the patient excretes radioactive iodine through his body fluids such as urine, sweat and saliva, with the inherent risk of contamination of members of the public and workers if they have direct contact with these materials [7].

In order to prevent such exposures, there are several guidelines for the treatment and monitoring of thyroid cancer, the most known from the American Thyroid Association [8], revised in 2015, and from European Thyroid Association [9], published in 2006. These protocols bring together evidence on evolution and treatment and attempt to establish a standardization of behavior for DTC cases. However, protocols that address this issue under the radiological protection approach are rare, among them it can be mentioned the most commonly used ICRP 94 [10], published in 2004, which addresses only the discharge of patients treated with unsealed sources, and TECDOC 1608 [11],

published in 2009. However, there remain daily practical issues concerning the reality of Brazilian public hospitals that obstruct the optimization of this practice. These difficulties and the respective solutions reached by our group is analyzed below.

The focus of this work is to demonstrate that simple attitudes in the workers routine of a Nuclear Medicine Service (NMS) interfere positively in the radiation protection of all those involved in the patient's hospitalization, also optimizing their well being during the procedure.

2. MATERIALS AND METHODS

During 18 years of functioning of the room for radioiodine therapy with approximately 600 patients treated, different work routines were used by professionals responsible for hospitalizations. Over time, these have been improved in order to optimize radiation protection measures and facilitate the entire team work .

In the current hospitalization model, the patient participates in a series of interviews. The first occurs on the appointment with the endocrinologist (in this day will be scheduled the day of hospitalization), when the patient receives written instructions about the reason for hospitalization, personal items that may or may not be taken, and other information regarding the preparation of the procedure. After this consultation, the patient is referred to an interview with the nursing team. At the meeting, one of the team members takes him to the room to present the space, as well as provides practical guidance, such as food delivery, number of baths to be taken and the importance of liquid intake, to ensure that he will always be guided and assisted, reducing his anxiety and eliminating possible doubts.

Then the patient undergoes an interview with the physicist of the sector, who is available to clarify possible doubts regarding the treatment with a radioactive material, paying attention to what kind of information the patient already has about hospitalization and its source . In most cases the patient arrives full of myths coming from queries of Internet search and conversations with lay individuals, generating stress and anxiety. It is not uncommon to hear comparisons between this procedure and Chernobyl Accident, for example. At this point, the intervention of the health professional who is dealing with this patient is fundamental in order to clarify these questions and replace the

previous information with the true knowledge [12]. Since most of our patients are in hypothyroidism, their cognition is often compromised, the information about the procedures to keep the room organized and with minimal generation of tailings is passed in both written and visual form, being presented by figures affixed to the walls in appropriate places (figures 1 and 2). This type of communication also helps in the understanding of information by illiterate patients, which are easily found in public hospitals. In addition, the physicist is also responsible for teaching the patient about radioprotection guidelines with his family after discharge, especially for patient that who may have contact with children or pregnant women.

The previous interviews are quick and simple and aim to provide clear information to the patient and his companion, if applicable. Table 1 summarizes what is covered in each interview:

Table 1: Topics covered in interviews

Interviewer	Topics covered in the interview
Assistant physician (endocrinologist)	Pre and post treatment diet Hormone replacement
Nurse in the Nuclear Medicine Sector	Presentation of the therapeutic room Care during hospitalization Positioning of the patient in nursing interferences during hospitalization
Physicist specialized in nuclear medicine	Radiation protection care during hospitalization Strategies for radiological protection after discharge at patient's home

In this first moment, it is very important that the professionals involved are attentive to the demands of the patient, not only the medical ones (previously prescribed remedies, additional health care, etc.), as well as the psychological issues. From the experience of our group, it was noticed that these demands are the most important when related to possible complications during hospitalization that can cause increase occupational exposures.

Figure 1: Relevant information posted on the walls of the room for hospitalization with radioiodine



Figure 2: Guidelines for patients with photos on bathroom walls



On the day of admission, the patient undergoes other interview with the responsible endocrinologist to hospitalization and perform pertinent clinical procedures. The patient is then taken to the room by the nursing staff, who guides him in relation to the organization that has to be adopted, fol-

lowing verbal and written sequence of procedures. On the same day, before the ^{131}I administration, the responsible physicist talks with the patient about possible doubts, and reviews the procedure guide and visual information posted on the walls.

We also draw attention to the written document provided to the patient in this interview. Even if he is not able to read, the document with the information passed during the first meeting must be delivered. A family member or companion may assist him in the subsequent reading of such information if necessary. It is important to keep in the room only what is necessary for his stay in the hospital, generating as few tailings as possible. Therefore, the following strategies were adopted: replacement of disposable cups, plates and cutlery by permanent ones, always making sure that they are easy to decontaminate, if necessary; guidance to patients so that, in the meals, the food received in the containers is gradually transferred to the dish with clean spoons, thus avoiding saliva contamination of the remaining food.

Lastly, we emphasize the great importance of team training. In this training, which should occur annually or each time a new member joins the team, previous experiences should be valued as examples of successful or unsuccessful situations so that employees can know how to proceed in normal and emergency situations in order to not receiving an unnecessary radiation exposure.

3. RESULTS AND DISCUSSION

It was noticed that the previous interview brought less anxiety to the patient, since he was already informed about the radiation protection routines to be adopted during the period of hospitalization and at home, post-discharge. The use of non-disposable materials minimizes the exposure of those responsible for clearing the room dealing with fewer radioactive waste and increases patient comfort during hospital stay, since there is a small amount of waste that could not be removed from the room during hospitalization. The meal remains, plates, cups, cutlery and napkins have to be measured and probably retained because radioiodine contamination due to the contact of these materials with the patient's saliva. With the replacement of all these materials by a plate and cup (made of glass or stainless steel) and stainless steel cutlery, the patient is in charge of washing these items after each use, reducing the amount of waste and, in tow, the exposure of the team that would have

to deal with this. The adoption of strategies to serve food also eliminated the need to store perishable material for radioactive decay.

It is well known that the guiding figures in the room assist the patient during his hospitalization, since it was noticed a reduction of waste and residues poorly positioned for lack of understanding, since it is the patient himself who discards all the tailings generated in his treatment.

Because of the previous interview, patients felt more 'welcomed' by health professionals and all the complications related to increased stress and anxiety, such as elevated blood pressure, anxiety attacks with drug demand, among others were drastically reduced to isolated and sporadic cases. These parameters were measured by the nursing record book, which shows how many times these professionals were called to provide care during hospitalization. All of the procedures described here are simple, immediate execution actions that are not costly for an institution and can reduce drastically the team radiation exposure.

During all these years of hospitalization, there were no cases of high effective dose to any staff member (above 1 mSv / month or 6 mSv / year, considered as a investigation level according to CNEN NN 3.01 [13]). In the improvement of the techniques described here, we have a maximum monthly effective dose of 0.2 mSv in comparison to prior results before the application of these guidelines (0.8 mSv). Another important transformation was the reduction of radioactive waste with a high exposure rate, which reduces the time spent in storage and also reduces the exposure of employees responsible for their management. Prior to such techniques, approximately 60 % of the stored tailings emitted more than 60,000 counts per second and after these measures only 20 % were recorded at this counting rate.

4. CONCLUSION

The team at the time of this work had 8 professionals (doctors, nurses and physicians) but 20 different professionals have already passed through this team . With the involvement of all these workers in the patient hospitalization in the radioiodine therapy room, there were increasing improvements regarding the reduction of interferences with the patient, minimization of tailings (increasing comfort throughout the process) and minimization of occupational effective dose for the

staff performing the radiation survey to release the room for cleaning. It should be emphasized that such proposals are not definitive actions for any nuclear medicine service in which they are applied. It is necessary to keep the team constantly updated and attentive to unprecedented demands that only experience with patients can provide.

As a suggestion, the authors would like to propose to the teams that perform this type of work that they keep up to date with periodic meetings, carrying out case studies with their past patients and thinking about how to improve care for next ones. And to improve the work of those who are most exposed to radiation who try their best to reduce the amount of disposable materials, replacing them with items that can be washed by the patients themselves during their stay.

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