Iodine-131 Saliva Secretion in Ablation Treatment for Thyroid Cancer Patients

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Abstract. In general, well-differentiated thyroid cancer treatment consists in Na\textsuperscript{131}I administration following total or a near total thyroidectomy. The activity of a single administration in the majority of nuclear centers ranges from 1 to 4 GBq for residual thyroid tissue elimination and ranges from 4 to 8 GBq for residual thyroid tissue as well as metastases elimination. The high magnitude of \textsuperscript{131}I activities administered for thyroid cancer treatment can lead to side effects, where salivary gland dysfunctions are the most common observed. In the absence of thyroid gland, secondary tissues – iodide specific uptake, mainly the salivary glands, rise at the element body retention process. In addition, among nuclear medicine professionals, there is no consensus about suitable restrictions that must be observed by the hospital released patient to avoid \textsuperscript{131}I contamination by saliva.

The aim of this study is to evaluate qualitatively the secretion of \textsuperscript{131}I by salivary glands after the administration of the radionuclide to thyroid cancer patients for ablation purposes. Well-differentiated thyroid cancer patients from Clementino Fraga Filho University Hospital (HUCFF) of Federal University of Rio de Janeiro (UFRJ) followed-up in the present study are female, adult and without additional health diseases detected. After \textsuperscript{131}I administration for ablation purposes, saliva samples were collected systematically and counting rate was assessed using a NaI(Tl) scintillator detector. As the study is at an early stage, the preliminary results concern the possibility of conducting an evaluation of \textsuperscript{131}I secreted in saliva using the proposed protocol. It can be seen that many factors have potential to influence the behaviour of \textsuperscript{131}I secretion in saliva, for example the use of Na\textsuperscript{131}I in solution or in capsules. It was observed two standards that can be defined according to these variables.

KEYWORDS: Iodine-\textsuperscript{131}; thyroid cancer; saliva secretion; nuclear medicine; radiation protection

1. Introduction

Although \textsuperscript{131}I has been successfully used for thyroid cancer treatment for six decades, there are still many questions concerning this procedure [1]. The general protocol for well-differentiated thyroid cancer treatment consists in \textsuperscript{131}I administration following total or a near total thyroidectomy. So the main source of the questions consists in the insufficient information about the biokinetics of the radioiodine in an athyreotic body and in so high levels doses sufficient to damage living tissues.

The treatment activities per administration vary among nuclear medicine centers [1,2]. In the majority centers, activities range from 1 to 4 GBq for residual thyroid tissue elimination and from 4 to 8 GBq for residual thyroid tissue as well as metastases elimination [1]. In case of persistence of undesired residual tissue, these high values could be repeated in future administrations.

The high magnitude of \textsuperscript{131}I activities administered for thyroid cancer treatment can lead to side effects [3,4]. Among nauseas, thyroiditis, hypothyroidism, salivary gland dysfunctions is the most common side effect observed after \textsuperscript{131}I administration for thyroid cancer treatment [5]. This high frequency of salivary gland dysfunctions after radioiodine treatment can be explained by the fact that in the absence of significant mass of thyroid tissue, secondary tissues – iodide specific uptake, mainly the salivary glands, rise at the element body retention process [6,7].

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Most of $^{131}$I administrated are excreted in the urine, $55.6\, (\pm\, 9.6)\%$, $67.4\, (\pm\, 14.5)\%$ and $72\, (\pm\, 10)\%$ were recovered within the first 24 hours [8, 9, 10, respectively]. Besides, for patient dosimetry purposes, there is also a concern about saliva iodine content, since a significant amount of the radionuclide is secreted via salivary glands which, with the iodine secreted into gastric juice, move into small intestine for reabsorption, consistent the enteric phase [6, 11].

In addition, among nuclear medicine professionals, there is no consensus about suitable restrictions that must be observed by the released patient to avoid $^{131}$I contamination by saliva. This situation constitutes a special radiation protection concern in cases involving children as patients or as close relatives of the treated patients [12]. However, little information is available on the distributions of radionuclides in the salivary glands [13], including the iodine.

The present work aims to evaluate qualitatively the elimination of $^{131}$I by salivary glands, as a function of time after the administration of the radionuclide to thyroid cancer patients for ablation purposes and this paper analyzes the preliminary results.

2. Methodology

Until now, five patients from University Hospital Clementino Fraga Filho (HUCFF) of Federal University of Rio de Janeiro (UFRJ) were prospectively investigated in the present study. All patients were female, with age ranging from 27 to 62 years, with papillary carcinoma, submitted to previous total thyroidectomy, non smokers, non alcoholic, without metastases and additional health diseases detected. Patients with previous history of radioiodine therapy or external irradiation were excluded. The uptake estimated values of remnant thyroid tissue ranged from 2.7 to 3.0 % and the Na$^{131}$I activity administered to these patients ranged from 3843 MBq to 6068 MBq. Rich-iodine diet and thyroid hormone replacement were withdrawn one and four weeks before $^{131}$I therapy, respectively.

The patients were instructed to drink as much water (suggested volume of 3 L or higher per day) and to use 2 drops of lemon juice every 2 hours after $^{131}$I administration. The patients were asked to collect her own saliva sample following the protocol that was previously explained and trained with each patient. Although the collections were always made by themselves, during hospitalization, some patients were monitored personally by at least one researcher of the team and others patients have the collections alone; depending on their general health conditions. It was not perceived any data differences related to this behavior.

Along the day, at least, for each two hours after $^{131}$I administration, the patients were asked to rinse their mouth with water and 3-5 minutes later, a round piece (2.5 cm Ø) of quality filter paper (Schleicher & Schull – Germany) was set on the anterior surface portion of tongue for 10 seconds (patients 1 to 4) and 30 seconds (patient 5), then it was removed and sealed. According to patient availability, saliva samples could be collected, but unsystematically, along the night.

Patients 1 and 2 received an oral administration of Na$^{131}$I solution and the other three patients received the radiopharmaceutical in capsules. The hospitalization lasted between 24 and 48 hours, the exact duration depended on the time required for each patient to achieve the level of exposure required by the regulations of the National Agency of nuclear energy for the release of patients, which is 1110 MBq [14]. Along the hospitalization time of each patient, it was collected 15 saliva samples, on average. The counting of iodine from saliva samples was measured using a 5.08 x 5.08 cm NaI(Tl) scintillator detector in association with a proper software.

3. Results

The analysis of the graphs shows two distinct behavior patterns between oral administration of Na$^{131}$I in solution and in capsules. In the pattern observed in samples collected from patients that received Na$^{131}$I solution (Figure 1), the maximum counting rates values were obtained from 14 to 16 hours after the radiopharmaceutical administration; while for patients that received Na$^{131}$I in capsules (Figure 2),
maximum counting rates values were observed previously, from 4 to 6 hours after ablation dose administration.

After reaching maximum counting rates values, saliva samples concentration of iodine levels fell rapidly, but did not reach basal levels within the period of follow-up.

**Figure 1:** Performance of the curves of counting rate per unit time of the group of Na$^{131}$I aqueous solution administration. Physical decay is corrected to intake time. (a) patient 1 (5402 MBq). (b) patient 2 (3843 MBq).

![Figure 1](image1.png)

**Figure 2:** Performance of the curves of counting rate per unit time of the group of Na$^{131}$I in capsule administration. Physical decay is corrected to intake time. (a) patient 3 (4033 MBq). (b) patient 4 (5550 MBq) (c) patient 5 (6068 MBq).

![Figure 2](image2.png)
4. Conclusions

As the study is at an early stage, the preliminary results suggest the possibility of conducting an evaluation of $^{131}$I secretion in saliva using the proposed protocol.

Factors like the use of lemon juice could influence the behaviour of $^{131}$I secretion in saliva. The use of Na$^{131}$I in solution or in capsules is another potential factor. In this study, it was observed two standards that can be defined according to these variables of radioiodine administration.

It is necessary to continue this study following more patients and associating the results with possible factors of disturbance of $^{131}$I secretion in saliva.

Acknowledgements

The authors thank the patients, for their important collaboration, and the Nuclear Engineering Institute and the Clementino Fraga Filho University Hospital, for the availability of their facilities along the study.
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