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UNDERSTANDING ISSUES IN PREPARING PATIENTS FOR RADIOACTIVE IODINE TREATMENT OF THYROID DISORDERS

Ahmad Zaid Zanial [1*], Fadzilah Hamzah [2]

[1] *Postgraduate Trainee, Nuclear Medicine Department, Hospital Pulau Pinang, Malaysia.*
[2] *Consultant Nuclear Medicine Physician, Head of Department, Nuclear Medicine Department, Hospital Pulau Pinang, Malaysia.*

**Corresponding Author Email: ahmadzaidx@gmail.com*

ABSTRACT

Thyroid disorders could be broadly categorised into benign and malignant diseases. Approaches for the management of benign and malignant thyroid disorders have been well documented including the treatment using radioactive iodine (RAI). RAI has long been used to treat hyperthyroidism and well differentiated thyroid cancer. Nevertheless, there are various factors that may influence the outcome of RAI treatment including matters related to patient preparations. Thus, healthcare personnel play an important role in assisting patients to make the necessary preparations. This article aims to give nurses and clinicians of various specialities an insight into the overview of RAI treatment for thyroid disorders particularly in Malaysia and further discusses the issues related to preparations of patients.

Keywords: Radioactive iodine, Hyperthyroidism, Differentiated Thyroid Cancer

INTRODUCTION

The oral administration of radioactive iodine (RAI) using radionuclide Iodine-131 (I-131) for the treatment of thyroid disorders has been a generally accepted procedure for the last 60 years (Silberstein *et al.,* 2012). Common indications of RAI treatment are benign thyroid disorders such as Grave's disease and toxic multinodular goitre as well as differentiated thyroid cancer (DTC). In our local setting, RAI is being dispensed orally as liquid solution. Radiations produced from I-131 are beta particles and high energy gamma rays (Silberstein *et al.,* 2012; Stokkel *et al.,* 2010). The thyroid gland receives the highest radiation of absorbed dose.

The underlying principle of RAI treatment is physiological whereby I-131 is taken up by iodide transporter of the thyroid glands and later processed in the same way as natural iodine (Mumtaz *et al.,* 2009). As the beta particles from I-131 travel few millimetres within the thyroid tissues, they destroy the follicular cells by disrupting chemical bonds within the cells, inflicting devastating damage on DNA molecules and subsequently triggering cellular dysfunction leading to eventual cell death (Pryma and Mandel, 2014). Absolute contraindications for RAI treatment include pregnancy and breastfeeding (Stokkel *et al.,* 2010).

Hyperthyroidism

Hyper-functioning of thyroid glands would inevitably lead to hyperthyroidism. The terms hyperthyroidism and thyrotoxicosis are interchangeably used (Topliss and Eastman, 2004). However, non-thyroid pathologies such as struma ovarii may also cause thyrotoxicosis. Examples of thyrotoxicosis symptoms are hand tremors, anxiety, palpitation, heat intolerance, excessive sweating and weight loss despite good appetite. Conditions such as pretibial myxedema, hypokalaemic periodic paralysis, thyroid eye disease and cardiomyopathy are the commonly described complications (Zainudin *et al.,* 2012). Grave's disease, toxic multinodular goiter and toxic adenoma are the frequently seen causes of hyperthyroidism (Topliss and Eastman, 2004; Bahn *et al.,* 2011).

Generally treatment options available for hyperthyroidism consist of anti-thyroid drugs, surgery and RAI therapy. In the local setting, the majority of

patients are treated medically with anti-thyroid drugs up to approximately 18-24 months before being tapered off. However, some patients may require RAI therapy or surgery especially when medical therapy fails. As the available number of centers offering access to nuclear medicine services increases, many of these patients are referred for RAI treatment. RAI therapy for hyperthyroidism is given as an outpatient treatment.

Most of the local centers prescribe fixed doses of RAI with consideration given to the size of thyroid based on clinical examination. A fixed dose of 370-555 MBq (10-15 mCi) is stated in the Malaysian consensus (Zainudin *et al.,* 2012). Fixed dose regime is simple, more convenient to use and effective to accomplish treatment objective (Mumtaz *et al.,* 2009). The treatment aim is to achieve a non-hyperthyroid status at one year post RAI therapy either a euthyroid state with normal thyroid function without any medication or iatrogenic hypothyroidism requiring thyroxine hormone replacement (Silberstein *et al.,* 2012; Lewis *et al.,* 2013; Yau *et al*., 2009).

Differentiated Thyroid Cancer

Thyroid cancer is one of the commonest reported endocrine cancers. Local data showed that the incidence of thyroid cancer to be more prevalent among middle aged women (Htwe, 2012; Ministry of Health Malaysia, 2006). DTC accounts for the significant majority of thyroid cancer cases and most patients have an excellent prognosis (O'Neill, 2010). DTC can be divided into papillary, follicular and Hurtle cell carcinomas. However, the cellular ability of DTC to accumulate and retain iodine is preserved (Pryma and Mandel, 2014). Common presentation of thyroid cancer is usually thyroid nodule that may progressively increase in size.

Diagnosis of a suspicious thyroid nodule is usually being done by fine needle aspiration for cytology (FNAC) or biopsy for histopathology examination (HPE) following ultrasound scan. Surgery by total or near-total thyroidectomy is the initial treatment of DTC whenever the diagnosis is made before surgery (Pacini *et al.,* 2012). RAI ablation has been widely accepted and has become an important component of the postoperative management of DTC (Woodrum and Gauger, 2005). Higher doses of RAI activity are used for treatment of DTC compared to benign thyroid disorders and patients are usually required to be admitted to the radioiodine ward.

Role of RAI in the management of DTC can be divided into 3 categories; (a) remnant ablation of thyroid tissue post-operatively to facilitate future monitoring of serum thyroglobulin, (b) adjuvant therapy after surgery for patients with increased risk of recurrence and (c) treatment attempt to destroy identified or suspected active macroscopic malignant disease (Woodrum and Gauger, 2005). Selection of RAI activity is usually based on the disease stage and risk stratification. In our local setting, the usual prescribed doses of RAI activity are 80-100 mCi for remnant thyroid tissue and 120-150 mCi for extra-thyroidal and metastatic disease.

Pretreatment Patient Preparation

Patients would receive written information and undergo briefing on the pretreatment preparations, therapy procedure, radiation protection and possible side effects as these are well recommended measures (Silberstein *et al.,* 2012; Stokkel *et al.,* 2010; Royal College of Physicians, 2007). In the local setting, pretreatment briefings are given by nuclear medicine clinicians or trained nurses. However, some patients whom are referred from other hospitals may receive initial explanation and information from the respective referring healthcare personnel. Compliance towards preparation measures is an important aspect in ensuring the efficacy of RAI treatment.

A state of iodine insufficiency should be induced in patients to promote RAI uptake by the thyroid tissue (Silberstein *et al.,* 2012). Hyperthyroidism patients are advised to stop consuming anti-thyroid drugs (1-2 weeks), multivitamin (1 week), iodine containing substance including expectorants and Lugol's iodine (2-3 weeks) and amiodarone (3-6 months or longer) as well as avoid radiographic contrast agents (3-4 weeks) prior to RAI therapy (Mumtaz *et al.,* 2009). For DTC cases, the thyroid stimulating hormone (TSH) level should be more than 30 μIU/mL in order to maximise I-131 uptake which can be achieved by withholding thyroxine hormones for one month or by injection of recombinant human TSH prior to RAI ablation (Silberstein *et al.,* 2012; Pryma and Mandel, 2014).

Patients must also be placed on an iodine restricted diet to ensure sufficient RAI accumulation. The timing of dietary iodine restriction for benign thyroid cases is not well documented although the recommendation for DTC cases could be as long as 10-14 days (Mumtaz *et al.,* 2009). In relation to the matter, pretreatment

urinary iodine test can be used to document compliance of the patients as it reflects recent dietary iodine intake (Park and Hennessey, 2004; WHO, 2007). Low iodine diets for DTC were shown to decrease urinary iodine measurements as well as appeared to increase I-131 uptake or lesional radiation when compared to regular diets (Sawka *et al*., 2010).

In our local setting, hyperthyroidism patients will undergo 1 week of dietary iodine restriction compared to 2 weeks duration for DTC patients. Though stringency is usually not being specified, the importance is being placed on the avoidance of seafood, food with high iodine contents, supplements and multivitamins. However, a more stringent dietary restriction may be needed for patients in certain areas with easy access to seafood and expected higher consumption of dietary iodine. Apart from providing patients with a structured dietary instruction based on local food intake, access to counselling by the dietitian should also be assisted to ensure compliance.

Pregnancy must be excluded before each RAI therapy and patients are advised not to conceive within 6-12 months of the last treatment. Women who are breastfeeding or have newly stopped lactating also should not receive I-131 since the recently lactating breasts may concentrate a considerable amount of iodide. Patients are advised to stop breastfeeding for about 6-8 weeks before RAI treatment (Pryma and Mandel, 2014; Cooper *et al.,* 2009). Cessation of breastfeeding should continue after the therapy and lactation can be undertaken following future pregnancy and delivery (Silberstein *et al.,* 2012; Sisson *et al.,* 2011). Some patients may also require cautious use of dopaminergic drugs to stop lactation (Cooper *et al.,* 2009).

CONCLUSION

Healthcare personnel play significant role in ensuring that all patients receive adequate information regarding the necessary preparations prior to RAI treatment and educate them on the importance of compliance. A state of iodine deficiency achieved by stopping certain medications and substance with high iodine contents as well as dietary iodine restriction is required to promote RAI uptake by thyroid tissue and treatment effectiveness. In addition, sufficient TSH stimulation is also essential for DTC cases. On another note, adequate pretreatment cessation of lactation is required as breastfeeding is one of the absolute contraindications for RAI treatment.

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