

## Protocol for Management of Hyperthyroidism by Radioactive Iodine (RAIT)-SNMB Guidelines

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Radioactive iodine therapy (RAIT) has been being a successful mode of treatment for hyperthyroidism since its use on 1941 in United State of America. Former Institute of Nuclear Medicine, Bangladesh Atomic Energy Commission first started the RAIT on 1981. Thereafter other Nuclear Medicine Centers have been practicing RAIT on hyperthyroidism. In this background, there was a need for uniformity of RAIT management protocol for hyperthyroidism. Society of Nuclear Medicine, Bangladesh (SNMB)-2002 had taken an initiative. A protocol for RAIT management for hyperthyroidism had been decided on daylong workshop on 14 August 2002 organized by SNMB with the consensus of specialists of Nuclear Medicine, Endocrinologists, Medicine Specialists and ENT Surgeons.

These guidelines for management of hyperthyroidism by RAIT was upgraded based on recent knowledge, clinical and practical experiences and decided on a seminar, 26 February 2015 by SNMB held in National Institute of Nuclear Medicine and Allied Sciences (NINMAS) auditorium.

### Thyrotoxicosis

Thyrotoxicosis refers to clinical syndrome that results from metabolic effects of excess thyroid hormone at the tissue level, regardless of the etiology. [Wartofsky 1996, Woeber 1999]

### Etiologies of thyrotoxicosis

1. Hyperthyroidism- Graves' disease, single toxic nodular goiter (STNG), toxic multinodular goiter (TMNG)
2. Thyroiditis
3. Factitious ingestion of thyroid hormone
4. Ectopic thyroid hormone production – Struma ovarii
5. Drug induced- over iodine, amiodarone, lithium, interferon  $\alpha$ , thalidomide
6. TSH induced- TSH secreting pituitary adenoma, choriocarcinoma and hydatidiform mole, follicular carcinoma of thyroid with or without metastases.

### Hyperthyroidism

It is due to inappropriately high synthesis and secretion of thyroid hormones by the thyroid gland.

### Categories of hyperthyroidism:

1. Graves' disease (GD)
2. Single Toxic Nodular Goiter (STNG)/Solitary Toxic Nodule (STN)/Toxic adenoma (TA)/ solitary thyroid adenoma (STA)/Autonomous Functioning Toxic Nodule (AFTN)/Autonomous Toxic Nodule (ATN)
3. Toxic multinodular goiter (TMNG)

**Diagnosis of hyperthyroidism depends on**

- History
- Clinical features
- Investigations

**Investigations:**

1. Serum free triiodothyronine (FT3), free thyroxine (FT4) & thyroid stimulating hormone (TSH).
2.  $^{131}\text{I}$  thyroid uptake- at 2 hours and 24 hours by giving 5-10  $\mu\text{Ci}$   $^{131}\text{I}$  orally
3.  $^{99\text{m}}\text{Tc}$  scan by giving 2 mCi  $^{99\text{m}}\text{Tc}$  I/V and scan after 20-30 min
4. Ultrasound imaging and Color Doppler Study (CDS) of thyroid gland for all patients of hyperthyroidism especially in pregnant women.
5. Thyrotropin receptor antibodies (TRAbs)-
  - a. Thyroid stimulating immunoglobulins (TSI), thyrotropin-binding inhibitor immunoglobulin (not available at present)
  - b. Other antibodies –antit hyroglobulin antibody (anti Tg Ab), anti thyroid peroxidase antibodies (anti TPO Ab) to differentiate from thyroiditis.
6. Complete blood count (CBC)
7. Liver enzymes

***$^{131}\text{I}$  thyroid uptake and  $^{99\text{m}}\text{Tc}$  scan are contraindicated in pregnancy and lactating mother***

**Patient selection for RAIT**

1. Patient must be an established case of hyperthyroidism
2. Patient must be referred by physician for RAIT
3. Contraindicated in case of pregnancy and lactation

**Indications for  $^{131}\text{I}$  therapy:**

1. Established hyperthyroidism- mild cases of hyperthyroidism  $^{131}\text{I}$  may be given

without pretreatment with antithyroid drug (ATD)

2. Following cases require pretreatment with ATD before RAIT:
  - a. Highly toxic patient (FT4- 2 to 3 times higher than normal level)
  - b. Cardiac patient
  - c. Patient with active ophthalmopathy
  - d. Old age
  - e. Low  $^{131}\text{I}$  uptake & high serum FT4
  - f. Patient with very large goiter

***Written consent should be taken before RAIT from each patient and in cases of children from guardian***

**Pretreatment protocol for GD:**

- a) Standard ATD-
  - a. Neomercazole- 15-45 mg/day in 3 divided doses
  - b. Methimazole (MMI )- single dose 10-20 mg/day,
  - c. Propylthiouracil (PTU ) 50-150 mg three times in a day
- b) ATD must be adjusted according to hormone levels and should be continued until patient is mildly toxic or euthyroid.
- c) When patient attains euthyroid or mildly hyperthyroid state,
  - a. Withdraw neomercazole 3-5 days before RAIT and resume 3-7 days after RAIT for 4-8 weeks.
  - b. In case of PTU drug should be withdrawn for one month before RAIT
- d) Co-morbid conditions should be treated before RAIT
  - a. Active ophthalmopathy will be treated by ophthalmologists- RAIT can be given in inactive state of ophthalmopathy
  - b. For cardiac problems- consult with cardiologist for management before RAIT

**Dose of  $^{131}\text{I}$  for Graves' disease -**

- Modified fixed dose: 10-15 mCi (370-555 MBq)

### Pretreatment for single toxic nodular goiter (STNG) & Toxic multinodular goiter (TMNG)

- ATD is not preferred for treatment of STNG or TMNG but may be given as pretreatment when toxicity level is high, serum FT4 level-2-3 times higher than normal.
- Patient should be treated with RAIT once toxicity is controlled or reduced

#### Dose of $^{131}\text{I}$ for STN

- 15-20 mCi (555-740 MBq) depending on gland size

#### Dose of $^{131}\text{I}$ for TMNG

- 15-25 mCi (555-925 MBq) depending on gland size

#### Graves' disease in children

We give RAIT in children when toxicity is not controlled with ATD as well as those who are allergic to drugs.

#### Dose of $^{131}\text{I}$ for children

- 3-8 mCi (111-296 MBq)

#### Radiation protection advice following RAIT

##### Radiation Precaution for 5-7 days

- No need of hospitalization
- Avoid close contact with people especially pregnant women and children
- Use separate bed
- Drink plenty of fluid and void frequently after RAIT
- Chew sour candy or citrus fruit or Vit C tablet after 24 hrs of RAIT
- Flush toilet twice after use
- Bath/shower everyday
- Use separate utensils
- Do not cook or feed a child
- Avoid pregnancy for 6 months

#### Follow up

**First follow up** visit is at 3 months, if necessary come earlier.

Thereby 3 monthly follow up for first year and then biannually.

1. Consult patient & give assurance

2. Serum FT3 or FT4 & TSH estimation- treat and advice according to serum report.
3. Give symptomatic treatment for complaints, if necessary
4. Refer to other specialists for other medical problems.

(Any fluctuation state of thyroid function should be followed up closely)

#### Outcome of RAIT

- **Euthyroid-** Follow up
- **Hypothyroid-** Levothyroxine supplementation 1.7  $\mu\text{gm}/\text{kg}/\text{day}$
- **Hyperthyroid-** short course of ATD and if toxicity persists 2<sup>nd</sup> therapy is recommended after 6 months.
- **Lag behind TSH with normal FT3, FT4-** FU for one year without treatment

**\*\*\* 2<sup>nd</sup>/consecutive dose of RAIT should be higher than the previous dose**

#### Thyroid Storm

Thyroid storm is a rare complication if  $^{131}\text{I}$  therapy due to rapid outpouring of thyroid hormones in blood secondary to radiation thyroiditis and sometimes-even death may occur. To avoid this condition, highly toxic patients are pretreated with anti-thyroid drugs to make them mild hyperthyroid or euthyroid. It may also induced by intercurrent illness especially infection.

#### Management of thyroid storm:

1. Carbimazole is administered at a dose of 20–30 mg every 4–6 hours.
2. Propranolol 1–2 mg/min IV every 15 min up to max 10 mg, 40–80 mg every 4–6 h IV dose (initially if haemodynamically unstable) or Esmolol 50  $\mu\text{g}/\text{kg}/\text{min}$  IV—may increase by 50  $\mu\text{g}/\text{kg}/\text{min}$  every 4 min as required to a max of 300  $\mu\text{g}/\text{kg}/\text{min}$  (Short acting).
3. Iodine (saturated solution of potassium iodide) -5 drops (0.25 ml or 250 mg) orally every 6 hours. Do not start until 1 hour after antithyroid drugs.

4. Hydrocortisone- 300 mg intravenous load, then 100 mg every 8 hours. Alternative drug: dexamethasone.
5. Other supportive measures should be taken-treatment of CCF, tachycardia, rehydration, multivitamins and antibiotic

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