Initial Radioiodine Administration

When to Use It and How to Select the Dose

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KEYWORDS

• Radioiodine • Thyroid cancer • Radioactive iodine • Guidelines

KEY POINTS

- All published guidelines on the use of radioactive iodine for the treatment of well-differentiated thyroid cancer agree that an individualized assessment of the risk of cancer-related mortality and of disease recurrence should direct the decision of whether radioiodine treatment is needed and how much to administer.
- With very-low-risk patients, there is no need for radioiodine ablation.
- For low-risk patients, remnant ablation with recombinant human thyroid-stimulating hormone–stimulated diagnostic scan followed by 131-I administration using a fixed empiric activity is recommended.
- For intermediate-risk patients, adjuvant treatment is used with higher activities of 75 to 100 mCi (2.8–3.7 GBq).
- High-risk patients require treatment of residual or metastatic disease; for the treatment of residual or metastatic disease, the author does not exceed 150 mCi (5.5 GBq) unless specifically guided by dosimetry and particularly for elderly patients.

INTRODUCTION AND HISTORICAL FACTS

Radioactive iodine has been used in the management of thyroid cancer since the early 1940s. In 1940, Hamilton and colleagues[1] described the first case of uptake of radioactive iodine by a cancerous thyroid. In 1942, Keston and colleagues[2] described the first cases of uptake by thyroid cancer metastases and noted appreciable accumulation of radioactive iodine in well-differentiated metastatic disease, whereas undifferentiated lesions did not demonstrate significant uptake of radioactivity. These initial observations provided the impetus for the development of treatments that used radioactive iodine, and Seidlin and colleagues[3] performed the first therapeutic administration of 131-I in 1946. Since these initial reports, several other studies have demonstrated that the use of radioactive iodine in thyroid cancer decreases the overall disease-specific mortality as well as the probability of having

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Endocrinol Metab Clin N Am 43 (2014) 385–400
http://dx.doi.org/10.1016/j.ecl.2014.02.003 **endo.theclinics.com**
0889-8529/14/$ – see front matter

disease recurrence.[4,5] Treatment with 131-I radioactive iodine represents today an essential component of individualized, risk-adjusted management of well-differentiated thyroid cancer. A growing body of scientific evidence provides a solid foundation that can be used as a reference by practitioners involved in the management of thyroid cancer. The use of radioactive iodine as one of the available therapies is discussed in the thyroid cancer guidelines developed by the American Thyroid Association (ATA),[6] by the National Comprehensive Cancer Network,[7] and by the European Consensus on Thyroid Cancer.[8] This article provides an overview of the current status of the use of radioactive iodine for the treatment of thyroid cancer after the initial thyroidectomy and reviews the current clinical guidelines, with the intent to provide a reference framework for an individualized use of radioactive iodine in the management of well-differentiated thyroid cancer. Areas of controversy are explored.

Patient follow-up after the initial radioiodine treatment and repeated radioiodine treatments are beyond the scope of this article and are not discussed.

DEFINITION AND OVERVIEW OF RADIOACTIVE IODINE TREATMENT

Radioactive iodine therapy is performed as an adjunct to total thyroidectomy in patients with well-differentiated (papillary and follicular) thyroid cancer. Radioactive iodine in the form of 131-I sodium iodide is administered orally, usually 4 to 6 weeks after total thyroidectomy. The radionuclide 131-I is a β- and γ-emitting radionuclide with a physical half-life 8.1 days. The principal γ-ray of 364 keV is used for imaging. The principal β-particle emission has therapeutic effect with a maximum energy of 0.61 MeV, an average energy of 0.192 MeV, and a mean range in tissue of 0.4 mm.[9] Treatment with radioactive iodine requires a well-coordinated multidisciplinary effort that involves surgeons, pathologists, endocrinologists, radiologists, nuclear medicine physicians, and physicists (**Fig. 1**). The initial disease staging is performed at the time of total thyroidectomy. Subsequent patient management and completion of staging requires the collaborative efforts of endocrinologists and nuclear medicine physicians so that residual thyroid tissue and/or disease is adequately stimulated via thyroid hormone withdrawal or the administration of recombinant thyroid-stimulating hormone (rTSH) for imaging and, when indicated, treatment with radioiodine. These initial steps in the management of thyroid cancer provide an estimate of the individual patient risk for cancer-related mortality and for disease recurrence that will guide the choice of the amount of 131-I to administer to each patient. Several systems have been developed to stratify patients prognostically, according to the estimated risk of disease recurrence and disease-specific mortality; these are discussed later. Risk estimation allows a targeted, individualized selection of the amount of radioactive iodine to administer to each patient so that the most appropriate radiation dose is delivered to the target tissue while minimizing the dose to normal radiosensitive tissues and, therefore, the possibility of side effects. When indicated, the intent of radioactive iodine treatment can

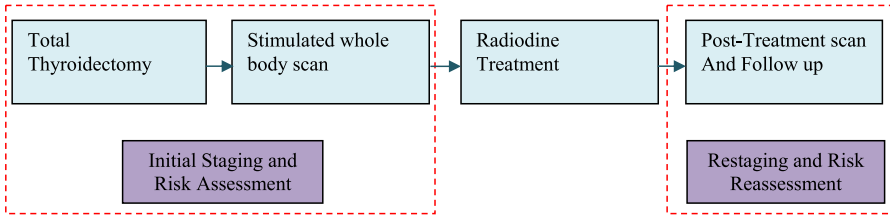

Fig. 1. Treatment with radioactive iodine.